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With The compliments of
Dr. Robt. C. Bryan





FUNCTIONAL DIAGNOSIS OF KIDNEY DISEASE

CASPER AND RICHTER

FUNCTIONAL DIAGNOSIS OF KIDNEY DISEASE

CASPER AND RICHTER

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FUNCTIONAL DIAGNOSIS
OF
KIDNEY DISEASE

WITH ESPECIAL REFERENCE TO
RENAL SURGERY

CLINICAL EXPERIMENTAL INVESTIGATIONS

BY

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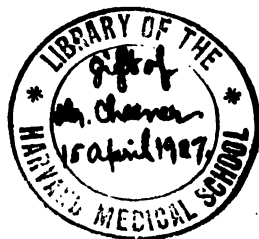
IN BERLIN

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PREFACE.

Owing to the advances in physical chemistry and through the introduction into medical practice of ureteral catheterization, Kidney Diagnosis has lately made the most gratifying progress. We have had opportunity on several occasions to refer briefly to our own participation in the work on the questions pending, and now publish the material which we have collected and investigated on this subject in the course of the last years. We hope that the results of our examinations will lead to a general utilization of the new method in Kidney Diagnosis.

We have been aided in our work by Herren Geh. Rath Koenig, Dr. Kümmel (Hamburg) and Professor Rotter, who placed appropriate material at our disposal. To them, as well as to Herr Geh. Rath Senator, in whose laboratory the physico-chemical investigations were carried out, we express our most sincere thanks.

LEOPOLD CASPER,
PAUL FRIEDERICH RICHTER.

BERLIN.

PREFACE TO AMERICAN EDITION.

We have been glad to give to Dr. Bryan and Dr. Sanford our consent to translate our work into English. We were the more pleased to do this since during the last years we have had opportunity to learn of the great interest our English-speaking colleagues have taken in this new field. If perhaps the circulation of the data contained in this work has been impeded in England and America, it has been no doubt due to the fact that many physicians of the English-speaking nations do not understand the German language. The present translation will help to overcome this evil. We shall be pleased to see our little volume in English garb, and have no doubt that it will stimulate many of the profession to make comprehensive research into this highly interesting, and for the patients, so important a subject.

It will soon be two years since this book was first published. In that time we have repeatedly been able to demonstrate that our practical kidney diagnosis is built on a sound and fruitful basis; sound, because the important facts have been confirmed on all sides, fruitful also, for kidney surgery has obtained benefit from it. Diagnosis is now more delicate; it has become

surer ; a provisional diagnosis which we can place under observation has become possible ; and as a consequence of more delicate diagnosis better results in kidney operations have been achieved—a thing however which was to have been expected.

We wish the best results for the work in question of our co-laborers, Dr. Bryan and Dr. Sanford, and thank them for the trouble and effort which they have expended in the translation.

DR. LEOPOLD CASPER,

DR. PAUL FRIEDERICH RICHTER.

BERLIN, GERMANY, April 9, 1903.

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FUNCTIONAL KIDNEY DIAGNOSIS.

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Besides looking at an organ from a mere anatomical point of view which studies the condition of the tissues, and the gross tissue changes, there is also the *physiological* side, where one seeks to become acquainted with the organ when it is at work, and where one's chief desire is to learn whether this work is suf-

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FUNCTIONAL KIDNEY DIAGNOSIS.

I.

PROBLEMS OF FUNCTIONAL DIAGNOSIS IN GENERAL AND ESPECIALLY OF KIDNEY DIAGNOSIS.

Among the undeniable advances in medical research in the last few years belongs the introduction into medical nomenclature of the idea of "Sufficiency or Insufficiency" of the various organs. It is not a question of introducing a new and apparently unnecessary form of expression, but of a real broadening and deepening of our diagnostic and therapeutic problems, in so far, as with this we endeavor to become familiar with the *amount of work* an organ can accomplish, and to determine definitely its *function*.

Besides looking at an organ from a mere anatomical point of view which studies the condition of the tissues, and the gross tissue changes, there is also the *physiological* side, where one seeks to become acquainted with the organ when it is at work, and where one's chief desire is to learn whether this work is suf-

ficient for the system or not. The diagnosis of the anatomical condition is the basis of all; indeed, in the majority of cases disturbances of function go hand in hand with anatomical changes, and therefore a knowledge of the latter is indispensable. But no less an authority than Rudolph Virchow has for more than fifty years stated how one-sided a purely anatomical consideration of a question can be, and how it must be necessarily substantiated and supplemented from a functional point of view. In his famous essay "Specificker und Specifickes," Virchow writes: "One may pay ever so great attention to anatomical, morphological, and histological study; one may spend further time in the research of indispensable and requisite fundamental principles of knowledge; but should one on that account declare that they are the only sure methods, that they alone are to be followed, that they alone are authoritative? Many important phenomena of the human body are purely functional, and although one may seek to explain them by a mechanical hypothesis as occurring through fine material, molecular changes, yet one must never forget that they can never be considered from an anatomical standpoint."

The credit of introducing into the clinical vocabulary the expression "*insufficiency*" in connection with several organs, and of creating interest in the importance of diagnosis from a *functional* basis, belongs to

O. Rosenbach. He was the first to use the term "*stomach insufficiency*" in the study of disturbances of the digestive tract; he further emphatically stated, as did Stokes even earlier, that this same idea could be also well used for diseases of the heart, and that for the physician it is not so much a question of the distinct well-marked pathological changes in the heart-muscle, as the disturbance of its physiological power of doing work.

O. Rosenbach had here in view principally the treatment: he concludes that a diagnosis of the functional power can far sooner detect the *beginning* pathological condition, and for this reason can lead up to appropriate treatment far sooner, than a diagnosis based on pathological changes which teaches us to detect organic lesions only after they are well developed, and often no longer reparable.

But the determination of the functional power of an organ, if one seeks to diagnose it exactly, is a rather vague matter and extends over wide ground. *The functional power of an organ depends partly on the condition of the organ itself, it further depends upon the momentary demands made upon the organ, and is therefore not an absolute but a relative quantity. And it will further be finally estimated by whether any, and if so, what amount of normal remaining portions of the affected organ itself, or other organs vicariously, take upon themselves the lost functions and act as a*

substitute for them. Even if one succeeds in measuring by exact methods the work of an organ at any moment, even then one cannot tell whether *in individual cases* this power of work is inadequate for the body, or whether, in so far as the organ is important to life, its continued existence is consistent with it.

One sees therefore that the tasks of functional diagnosis are far more comprehensive and difficult than those of anatomical diagnosis. The latter have to do with given quantities, with types; they base themselves on pictures of organic changes which in general always take the same course. On the contrary, functional diagnosis must first create for itself new values; it does not work with general conceptions which can be made to fit into a stable scheme, but it must construe the conditions it finds from the individual special peculiarities of each single case, and the singular features it presents.

When we, after a large amount of personal research, undertake the subject of the *functional diagnosis* of an organ for which, as will soon be explained, this is of the greatest practical importance, namely the kidneys,¹ we by no means underrate the difficulties of such a task. For there is even another hindrance, besides those already mentioned, in answering clearly

¹ Years ago, Senator drew attention to the importance of this point of view in renal disease. Discussion in the "Verein für innere Medicin," 23 Mai, 1892.

the question whether a "*Kidney Insufficiency*" exists or not, and that is that the kidney is a *double* organ, of which *one can, and often must take upon itself the functions of both.* And so it is not only a question of knowing the amount of work of both kidneys, but also that of each. While a knowledge of the former is important for those renal diseases which come into the range of internal medicine, so is the answering of the second question of decisive significance in the consideration which comes up before every radical kidney operation: Will the remaining organ be capable of taking the place of the removed kidney? As to the eminently practical importance of this question, and with it of functional kidney diagnosis, no further explanations are needed, especially at a time when renal surgery has made advances so unanticipated, and when its technical difficulties have been overcome.

We shall make ourselves more clear if after we have stated the general conditions in kidney affections, we explain now more in detail in what respects the method of functional diagnosis will throw light on the subject, especially *in surgical renal disease.* In place of longer abstract explanations, let us take a concrete example, a case of a tumor of the kidney; by it we will best be able to show in what directions we wish to apply the method. What we wish to know principally is this: *is one justified in assuming that after an operation, that is, after the eventual removal of*

the diseased kidney, the functioning power of the remaining organ will be sufficient for the purposes of the body? To answer this question we must next determine whether before the operation an insufficiency of the kidneys exists or not. In this case if the kidneys do not perform enough work, then we have established an incomplete functioning power of the supposedly sound organ, and the chances of a favorable outcome after an operation are appreciably diminished. But if on the contrary a sufficient functioning power of both kidneys taken together has been proved, still our diagnostic problem is by no means worked out. For we do not know upon which of these two kidneys the brunt of the work falls, the diseased organ destined for removal, or the supposedly sound one which is to remain. *For it is always in the bounds of possibility that on the diseased side the remaining normal kidney parenchyma is doing more work than the kidney which is apparently capable of its normal function, and that on this account only, as soon as an extirpation of the one kidney is performed, a renal insufficiency will appear which had not previously existed.* This shows that we must endeavor to determine how the kidneys divide the work among themselves, and that *beside a knowledge of the combined work of both, it is an indispensably necessary postulate for an opinion as to the operative chances, to know how much work each kidney does.*

To determine this the hypothesis naturally is that we can collect separately the secretion of each kidney; for the work of a gland, at least, as seems most rational, must be measured by its product, its secretion. The possibility of doing this we owe to catheterization of the ureters, and the principal importance of this procedure lies in the fact that at present it presents the only solution to the problem of determining the work of each kidney, and what is more, a measurement which can be expressed in exact figures. "For knowledge only begins where measure and figures are taken into account." (*Stokvis.*)

It is on all sides acknowledged that catheterization of the ureters, at least in the great majority of cases, permits the recognition of the presence of a *pathological* kidney condition. Even if it offered alone the possibility of surely diagnosing a diseased kidney, that would be a truly considerable advance, but in view of our foregoing explanations still not our highest diagnostic aim. On the contrary, we could even practically do harm through such knowledge. We know from repeated experiences, how long a kidney which shows pathological changes can carry on its function, without any bad influence resulting on the system, because the tissue degeneration never attacks all portions of the kidney parenchyma evenly, and the remaining portion can, at least for a long time, so increase its work compensatorily that the defect can be wholly covered up.

It is not upon the *pathological changes* in the kidneys which make themselves apparent through certain morphological admixtures and abnormal chemical constituents of the urine, that the fate of kidney patients depends, but upon the amount of *functional impediment* which exists in the apparatus for secreting the urine. Especially emphatically has König lately restated that a pathological condition of the remaining kidney presents in itself no absolute contraindication to a radical operation (nephrectomy). "Although it was previously held necessary that the second kidney should be absolutely normal, we know to-day that after the removal of tuberculous kidneys, patients can live for years and lead a bearable existence with a moderate amount of disease in the second kidney."¹ A classical example of the truth of this opinion is a case observed and reported by König, in which after the removal of an almost wholly degenerated tuberculous left kidney, symptoms soon appeared (cloudy, bloody urine), which, with the greatest appearance of truth pointed to a disease of the *right kidney* also. In spite of this the patient was perfectly well for a long time, and it was not until seven years after the operation, during a puerperium, where apparently increased demands were made upon the kidney, that death occurred.

Israel is of the same opinion when he says:² "If

¹ Deutsche Zeitschr. für Chirurgie, 1900.

² Berliner klinische Wochenschrift, 1899.

we should exclude from nephrectomy all cases where an abnormal secretion of the other kidney was found, the beneficial results of kidney surgery would be considerably diminished. In the decision of whether a nephrectomy is indicated, it is not so much a question of knowing whether the other kidney is anatomically well or diseased, but much more whether it is still able to perform enough work to in itself fulfill the body needs, whether its disease is capable of recovery, and whether in reference to the last point the operation would have a good or bad effect upon it." We agree fully with these statements so far as they place the determination of kidney function in the foreground of our diagnostic tasks. But when Israel continues: "These most important questions however are at present not solved by the ureter catheter, neither by the morphological nor chemical properties of the urine collected by it, and on that account the catheterization of the ureters has far from met the expectations which its introducers have attributed to it," we hope in what follows by sufficient practical material to show that this opinion is not correct.

Certainly one cannot hope to accomplish the impossible even from ureter catheterization, to show "whether a pathological kidney condition is capable of recovery" or "what effect an operation would have in this respect"; that cannot be objectively determined, one must simply form a subjective opinion from the

light of experience. Wider experience will at all events give to these personal decisions of the operators an ever increasing degree of correctness. But what can be objectively determined is the functioning power of the kidneys, and we shall see what an important rôle in the solution of this question the catheterization of the ureters plays.

To recapitulate, there are two directions in which we expect diagnosis of kidney function will give us information.

1. *We must find out: How are we to gain an idea of the amount of the total work done by the kidneys, and how shall we decide whether this amount of work is sufficient or insufficient for the body?*

2. *How shall we learn how the work of the kidneys is divided, how shall we definitely decide how much work each kidney does?*

II.

THE IMPORTANCE OF FUNCTIONAL DIAGNOSIS OF THE KIDNEYS IN SURGERY.

The endeavors of functional diagnosis of the kidneys as we have described them would be justified if the pathology of the kidneys presented only a small field for surgical procedure. How much more is that true when we remember how extensive a field kidney surgery has acquired for itself. For two thousand years it has been neglected, but the last thirty years have richly retrieved what has been left undone.

Even two thousand years ago the father of medicine, Hippocrates, urged making an incision in cases of suppuration of the kidneys, a piece of advice which makes his wonderful penetration and his divining talent for medicine all the more apparent when one considers that till well into the eighteenth century this recommendation was combated by the majority of even the most important scholars. Celsus, who lived about the time of Christ's birth, considered a wound of the kidneys absolutely fatal. Galen, in speaking of suppuration of the kidneys, says nothing of operative intervention. At the time of Avicenna, in the eleventh

century, an incision into the kidney seems to have been undertaken from time to time, and Guy de Chauliac in the fourteenth century speaks of kidney stones, which are to be treated by the aid of surgery; still in these cases it seems to have been more a matter of theoretical consideration, as reliable descriptions of such operations having been undertaken are wanting. In the following centuries the opinion more and more gained prevalence, that kidneys containing stones should be cut down upon as soon as they suppurated, while the simple nephrolithiasis seemed to remain a *noli me tangere* (Hévin, 1757). But even in the presence of suppuration, it was always a question of simply incising the abscess. The danger of wounding the kidney parenchyma was ever before the eyes of the physicians, and even Rayer in his brilliant work on kidney diseases in 1841 speaks of nephrectomy as an adventurous operation.

It was Thomas Smith, an English surgeon, who was the first in 1869 to propose cutting down upon the kidneys and laying them bare, even without suppuration being present, in order to palpate them. While after this investigator, opinions began to be formed which still hold good to-day, an event at the same time took place which was decisive for the whole development of kidney surgery.

On August 2, 1869, Gustav Simon, in Heidelberg, performed for the first time a nephrectomy with good

results, and this proved that not only could this organ so long considered indispensable be removed without harm to the patient, but even be followed by recovery from the disease. Simon undertook a second nephrectomy in 1871, and although the operation was followed by the death of the patient on the thirty-first day, still the way was smoothed for further advances by other investigators.

Kidney surgery in the following years made unanticipated strides. To the important fact that a patient's kidney could be removed without danger to life, was added another by Morris in 1880: He made an incision through the kidney parenchyma, and this proved that this operation, which had not up to that time been attempted, could be carried out without danger. Le Dentu showed later that the hemorrhage caused by cutting through the kidney parenchyma could be stopped by stitches, and Tuffier taught the so-called "Section-incision" of the kidneys, by means of which as little as possible of this important organ's tissue is destroyed. When one also considers that procedures on the pelves of the kidneys, and plastic operations have been carried out with good results, and that following Israel's example, the ureters can now be reached by the knife extraperitoneally, one may rightly claim that kidney surgery, as far as technique goes, has reached a high stage of development.

It would be beyond the province of this work to go

into further details of the advances in the technique of kidney surgery. We shall only describe the great steps of development in which the technical improvements have been perfected, in order to state what results have been accomplished by the aid of these advances. Have we reached the height of the attainable, or can we do still better than anything that has yet been offered?

Let us look over the statistics of famous operators, and we shall see that the percentage of mortality is still high.

Czerny lost out of 33 nephrectomies 51 per cent.

Tuffier lost out of 8 nephrectomies 37.5 per cent.

Küster lost out of 14 nephrectomies 28.5 per cent.

Bardenheuer lost out of 37 nephrectomies 21.6 per cent.

Schede lost out of 38 nephrectomies 21 per cent.

Thornton lost out of 25 nephrectomies 20 per cent.

Israel lost out of 37 nephrectomies 16.2 per cent.

In this category are included nephrectomies performed for various reasons. Of the 33 nephrectomies done by Schede, Küster, Bardenheuer, Thornton, Tuffier, and Czerny, for malignant tumors, 54.5 per cent. died, and of those reported by Israel in 1894, 16.6 per cent. terminated fatally. Of the operations for hydronephrosis, calculi, and tuberculosis of the kidney, Czerny lost 46.4 per cent., Schede 40 per cent., Bardenheuer 25 per cent., and Israel 22.5 per cent.

In regard to these collections of figures it must be stated that they are not of late date, and it is probable that in the statistics comprising cases which have been operated in the last years, the mortality rate will be appreciably smaller as a result of wider experience and improved technique. However, the latest statistics that we have of König's covering 18 cases of tuberculosis of the kidney, still show 33.3 per cent. mortality following the operation.

The names of the surgeons mentioned are a guarantee that these operations were undertaken with the greatest imaginable precautions and we may be sure that all avoidable complications, as for example the evil influences of chloroform narcosis and antiseptics, were as far as possible combated or diminished. And although the rate of mortality in other operations is more favorable, especially in intestinal and gall-bladder work, and laparotomies which from the technical standpoint as well as on other accounts must be considered fully as dangerous, we must yet seek the reasons for this on other grounds.

We can easily discover them in the advances made in the last years in diagnosis, and more than all in the possibility of obtaining the secretion of each kidney separately. In these operations covered by the statistics quoted, one point was not sufficiently considered, and what is more, could not be properly considered, because we did not at that time possess the technique

the diseased kidney, the functioning power of the remaining organ will be sufficient for the purposes of the body? To answer this question we must next determine whether before the operation an insufficiency of the kidneys exists or not. In this case if the kidneys do not perform enough work, then we have established an incomplete functioning power of the supposedly sound organ, and the chances of a favorable outcome after an operation are appreciably diminished. But if on the contrary a sufficient functioning power of both kidneys taken together has been proved, still our diagnostic problem is by no means worked out. For we do not know upon which of these two kidneys the brunt of the work falls, the diseased organ destined for removal, or the supposedly sound one which is to remain. *For it is always in the bounds of possibility that on the diseased side the remaining normal kidney parenchyma is doing more work than the kidney which is apparently capable of its normal function, and that on this account only, as soon as an extirpation of the one kidney is performed, a renal insufficiency will appear which had not previously existed.* This shows that we must endeavor to determine how the kidneys divide the work among themselves, and that *beside a knowledge of the combined work of both, it is an indispensably necessary postulate for an opinion as to the operative chances, to know how much work each kidney does.*

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Virchow's Archives, was able in the same year to get together 48 well-observed cases of single kidney, and Ballowitz¹ in 1895, as a continuance of Beumer's work, brought out a table of 213 pure cases of one-sided congenital failure of the kidney.

Mankiewicz² brings forward 21 further cases of the same sort collected during the last few years: Nineteen of these, which are reliably reported, we give in outline:

1. P. GUTTMANN. [Verhandl. d. Berliner med. Gesellschaft, 30 Nov., 1887. Berliner klin. Wochenschrift, 1887, 51, p. 972.]

Forty-seven-year-old man, death due to granular atrophy of the liver, large amount urine in spite of ascites. *Left kidney absent, right kidney greatly hypertrophied*, with two arteries. *Ureter opens into the middle of the bladder*. Left supra-renal body absent, no anomalies of the genital organs.

2. CHAVANNEZ. [Rein unique, avec vaisseaux supplémentaires. Capsule surrénale unique, etc. Société de médecine de Bordeaux. Journ. de Méd., 1892, 51. Annal. des mal. des org. génit. urin., 1893, p. 73.]

The *right kidney* lying over the spinal column is *somewhat larger* than normal: the supra-renal body is also hypertrophied. Besides a normal hilus and vessels, on the inner border are three extra vessels. *The left kidney is absent*. At first the genitals give the impression of being female. The scrotum compresses between its two portions the penis, which more resembles a large clitoris. In the right scrotum is a soft atrophic testis: the left testicle is small and fixed in the inguinal canal. The penis is attached by two folds of skin in

¹Ballowitz: Virchow's Archives, 1895.

²Loc. cit.

such a position as to make coitus practically impossible. Patient has left pes equino-varus.

3. CHRÉTIEN. [Absence congénitale d'un rein. Société d'anatomie, Nov., 1895. *Guyon's Annal.*, Feb., 1896, p. 174.]

A three-months-old child died of pulmonary tuberculosis: at the autopsy *a congenital absence of the left kidney, as well as of the left ureter*, was found. The left supra-renal body occupied its normal position. The right kidney lay deeply, and was normal except for a dilated pelvis and ureter.

4. G. PERTHES. [Ueber Nierenexstirpationen. *Deutsche Zeitschrift für Chirurgie*, 1896, XLII., p. 204.]

Perthes found during a study of a series of cadavers in regard to kidney surgery, an absence of one kidney in the very first case. As the preparation showed, *on that side was an absence of kidney*, kidney vessels, and ureter, and *no trace of an ureteral opening in the bladder*.

5. J. JOLLY. [Rein unique. *Soc. Anat.*, 9 Jan., 1896.]

A patient who died of heart disease showed at autopsy only one kidney, the left; it was 19 cm. in length, 85 mm. in breadth: the ureter and its opening in the bladder were normal. On the right side of the *Trigonum Lieutadii* *was a ureter opening, which could be catheterized for 1 cm.*, beyond was a fibrous band 13 cm. in length corresponding to the ureter. *The right kidney was wholly absent*.

6. JAMES ISRAEL. [Verhandl. d. freien Vereinig. d. Chirurgen Berlins, 1897, IX. Abdr. aus der Deutschen med. Wochenschrift, 1896-97.]

Left-sided solitary kidney, which was discovered by chance at the autopsy of a 52-year-old man who had died of diabetic phlegmon. *The right kidney as well as the right renal artery was totally absent*. The testicle on that side was not present in the scrotum. *The left kidney was greatly enlarged*, the ureter took its origin from the middle of a mass of kidney substance surrounding the kidney pelvis.

In the bladder was *only one ureteral opening—that on the left*.

7. GRÉNET. [Deux Observations de rein unique avec absence de l'uretère correspondant au rein manquant. Soc. anat., Dec., 1897.]

A consumptive, who always showed traces of albumen in the urine, died of erysipelas. At the autopsy was found a *total lack of left kidney, ureter, and ureteral opening in the bladder*, also of left renal vessels. Right kidney normal, as well as supra-renal bodies, and genital organs. The right normal kidney weighed 475 gm. with a small amount of epithelial nephritis, and was hypertrophied.

8. CHASSAING (DE CLERMONT FERRAND). [Société anatom., April, 1897.]

Solitary kidney found at an autopsy 10th March, 1897. On the right side no trace of kidney or supra-renal body. The kidney present was on the left, large (11, 10, 3, cm.), and by two furrows divided into three parts. *Only one ureter.*

9. M. C. HUSSENET. [Tuberculose rénale (rein gauche avec absence du rein droit). Arch. de méd. et de pharm. milit., März, 1897, XXIX., p. 210.]

A soldier, 21, who had earlier been treated for frequency of micturition, polyuria, and nephritis, was sent into the hospital with gastric symptoms. Patient showed following symptoms: Syncope, retention of urine, painfully dilated bladder, severe diarrhœa, delirium, albumen in cloudy urine, later incontinence. Tubercle bacilli found in urine—death. Only in the last days of patient's life after finding the bacilli in urine, could a diagnosis of genito-urinary tuberculosis be made.

Autopsy: *Solitary left kidney*, weighing 330 gm. (three times normal size). On the convex surface, about in the middle was an abscess the size of a hen's egg. Almost everywhere else were moderately large tubercles with cheesy masses. Ureter dilated. *No trace of right kidney*, right supra-renal body in normal position.

10. G. E. BREWER. [Some Observations upon the Anatomy of the Kidney. Medical News, 1897, VII., 31.]

In one case *the left kidney, vessels, and ureter were totally lacking*. The right kidney was twice the normal size.

11. EBSTEIN. [Virchow's Archiv., 1896, CXLV., p. 158.]

A 21-year-old girl had albuminuria following scarlet fever. While in the hospital no albumen, but hoarseness, pulse and respiration increased. Mucopurulent, bloody sputum, large amount urine. Pains in abdomen. Sudden death. *Right kidney, right ureter, right horn of the uterus, and right tube absent*. Left ureter narrowed by pressure from left horn of uterus. Above this point dilated: chronic pyelitis, atrophic nephritis, cysts and abscesses in the left kidney. *Absence of right ureteral opening in bladder*.

12. H. GOLT. [Absence of one kidney. British Med. Journal, Oct. 30, 1897.]

In the case of a 64-year-old man who died in diabetic coma, *the left kidney, supra-renal body, veins, arteries, and ureter were wholly absent*. Right kidney enlarged; normal.

13. GRÉNET. [Deux Observations de rein unique, avec absence de l'uretère correspondant au rein manquant. Soc. Anat., Dec., 1897.]

One-year-old boy died of phthisis. Right kidney is hydronephrotic: the parenchyma atrophic and the ureter greatly dilated. 1 cm. from the bladder the ureter is sharply compressed, which explains the hydronephrosis. *Left kidney and ureter absent*, as well as the renal vessels of that side: no trace of a ureteral opening in the bladder: on the left side no anomaly of genital organs.

14. HOUZEL. [Cyste hydatique du rein pris pour une tumeur solide de cet organe: nephrectomie; rein unique: mort d'urémie le cinquième jour. Gaz. médic. de Strasbourg. Rev. de Chirurg., 1898, 692.]

In 1888, a 26-year-old woman, two years after the birth of her child, noticed a large slowly growing tumor in her left side. This became so large and painful that, at the end of 1890, the patient was incapacitated for work, and had attacks of dyspnoea and syncope. The tumor filled the whole left side,

extended two fingers' breadth over the median line, was as hard as a fibroma, without fluctuation, and slightly movable.

Transperitoneal nephrectomy on the 30th of April, 1891.

The tumor presented itself as a sterile hydatid cyst with thick calcareous walls, whose cystic nature was first recognized in the course of the operation. As it could be easily shelled out, nephrectomy was undertaken. The mass was freed above and below, then the afferent vessels tied off. Houzel then came upon a ureter, which was separated between two ligatures, and then met with a *second ureter*. *It was a case of solitary kidney*. The operator naturally abandoned a nephrectomy, and applied an elastic ligature, to remove the cyst, and leave behind the remnant of kidney. Unfortunately it was already separated from its vessels: it was too late. Complete anuria followed with *death on the fifth day, exactly as if a physiological experiment had been performed*.

15. Verhoogen. [Annales de la Société Belge de Chirurgie, 1898, VI., p. 246.]

J. W. 40, well-nourished woman, commenced to have trouble in passing her urine three years ago, which was accompanied by burning at the end of micturition. At the same time the urine was often red with blood, later its sediment was mucopurulent. Her condition gradually grew worse until at present she is much emaciated, is anæmic, and has no appetite. The urine is very purulent and contains tubercle bacilli. The right kidney is very large, tender on pressure, and immovable. Cystoscopy impossible on account of bladder intolerance. At the operation on the 7th of May, 1898, the kidney was found adherent over its whole surface (perinephritis): on account of the bad condition of the patient simply a large incision was made, and all accessible cavities flushed out, tamponned, and drained. That evening very poor condition, no urine passed, bladder empty. The dressing soaked with urine. *Death* on the next day. *Total absence of the left kidney*.

16. KEEN AND JOHNSON. Rupture of the kidney. No operation. The wounded man died from shock and hemor-

rhage. It was found at the autopsy that *the other kidney was absent.*

17. CASE REPORTED BY GROSS. Schetelig removed a solitary kidney, the patient died of anuria.

18. KÖNIG-PELS-LENSDEN. [Die Tuberculose der Niere, Deutsche Zeitschrift f. Chirurgie, Marz, 1900, LV., Beob. 3, und Hildebrandt, Deutsche Zeitschrift f. Chirurgie, 1895, p. 143, 7.]

Herr N. 30, was troubled in 1879 with urinary symptoms. Frequent tenesmus with passing of very dirty urine appeared. Suddenly the urine was retained for a day, or a day and a half accompanied by severe pains in the right kidney region, then again to flow in increased quantity, and with no trouble. The crumb-like sediment contained much detritus, a large amount of bladder epithelium, at times cylindrical, and more often blood corpuscles and leucocytes. By rectum a tumor as large as a hazel-nut was to be felt above the prostate and to the right. In addition, a swelling developed in the right testicle, the left testicle was not present (1881). As a result of this while the patient was in Egypt, a right paranephritic abscess formed which was drained. The patient came with an urgent desire for an operation, and was in a very bad condition. Urine cloudy, purulent, contained leucocytes and much detritus besides epithelium, and a considerable quantity of albumen. At that time a painful tumor was palpable on the right side under the liver. In the meantime the attacks of anuria described above increased in number, and although they were interrupted by normal intervals, suddenly a lasting retention of urine developed. Uræmic attacks finally caused death. Autopsy: Tuberculosis of lungs, spleen, and liver. *The whole urogenital apparatus on the left, testicle with spermatic cord and seminal vesicle, kidney and ureter absent.* Right kidney enlarged, and filled with tuberculous foci in calices and pelvis. Ureter ulcerated in many places. A cystoscopic diagnosis of the ureter defect on the left side could not be made on account

of the great degree of sensitiveness of the bladder, and the continual presence of cloudy urine.

19. SPRINGORUM. [Med. Ges. zu Magdeburg, 15th Dec., 1898. Münchener med. Wochenschrift, 1899, 8, p. 270.]

A 61-year-old woman with total anuria due to an impacted stone of the right kidney. Nephrotomy, the pelvis of the kidney moderately enlarged, no stone. Tamponnade on account of smart hemorrhage. *Death* on the next day. Autopsy: Large right kidney with severe grade of degeneration of the kidney parenchyma. 5 cm. below the kidney pelvis a calculus firmly impacted in the ureter which totally obliterated its lumen. *No left kidney present*, and no trace of left ureter.

II. The second class of cases, those where both kidneys are united to one another, and also those where a formerly normal kidney has totally degenerated, have from a clinical standpoint the same significance. The growing together of two kidneys into one organ, whereby the form of a "Horse-shoe" or "Kuchen" results, and on that account the name "Horse-shoe" or "Kuchenniere," appears to be by no means so seldom an occurrence. Quite a considerable number are mentioned in the literature, out of which we here describe 6, which are of especial interest.

I. A CASE OF SOCIN'S,¹ of a woman of 47, who for 30 years had suffered from attacks of colicky pain accompanied by the appearance of a tumor in the right hypochondrium, and on whom a nephrectomy was performed in the following manner. The right kidney was found joined to the left by a tissue bridge 4 cm. wide, and 2 cm. in thickness, which extended across the vena cava, the spinal column, and the abdominal

¹ Beiträge zur klinischen Chirurgie, IV., 1.

aorta. The right kidney together with this bridge of tissue was cut away by means of a thermocautery and a knife from the under and outer edge of the sister organ and removed. The patient recovered.

2. THE CASE OF BRAUN.¹ Pyelonephritis calculosa in the right half of a horse-shoe kidney in a 45-year-old woman. March 7, 1881, median abdominal incision. *Death from hemorrhage at the end of the operation.*

3. A CASE OF KÖNIG'S.² He removed a sarcoma of the kidney the size of a man's head from a little girl; the operation, which was done intraperitoneally, showed unfortunately that the tumor belonged to the *right portion of a horse-shoe kidney*. This lay across the lumbar portion of the spinal column, had double vessels, double kidney pelves, and *double ureters*. The kidneys joined each other in the middle line by their under poles, and were grown together. At the point of junction the left kidney was sewn off with catgut stitches, and the right kidney removed with the tumor.

4. A CASE OF LOTHEISEN'S.³ A laborer, 28 years with hypospadias and right undescended testis, had in 1883 a tumor the size of a goose egg in his abdomen: in 1890 colic-like pains in attacks lasting up to two hours: rapid growth of the tumor, which was not movable, smooth, fluctuant, extending somewhat to the right of the median line, and originating retro-peritoneally in the left half of the abdomen. Splitting of the mesocolon and puncture of the cyst thus disclosed yielded a liter of chocolate brown fluid. A transverse incision through the abdominal wall was then made to enlarge the field of operation, and the cyst shelled out, when it was seen to take its origin

¹Deutsche med. Wochenschrift, 1881.

²Hildebrandt: Deutsche Zeitschr, f. Chirurgie, 1895, 92 und König-Pels-Lensden: Deutsche Zeitschrift für Chirurgie, 1900, LV., p. 8.

³Lotheisen: "Ein Beitrag zur Chirurgie der Nieren," Archiv für klin. Chir., 1896, 52, p. 768.

from a distended kidney pelvis. A second adherent cyst was difficult to remove. As the kidneys came more into view, *a horse-shoe kidney was recognized*. In order to remove the cyst, a portion of kidney substance was taken away with it by thermocautery. To check the severe hemorrhage from the renal tissue, three stitches were placed in the middle of the horse-shoe, and by these the kidney was carefully drawn together. Iodoform gauze, partial sewing up. Little excretion of urine, pilocarpine, opening of abdomen. Removal of two of the stitches in the kidney. *Death*. The kidney was subperitoneal in the extended mesentery of the sigmoid flexure, with the pelvis forward and to the left. *The left ureter was impassable*.

5. AN IMPORTANT CASE OF TULLY VAUGHAN.¹ A 38-year-old man, without urinary symptoms, died of acute peritonitis following an intestinal resection. *No left kidney was present*: only a fully developed kidney capsule 5.4 cm. was found, to which an artery passed from the abdominal aorta. On the right side was an enormous L-shaped kidney, as if both organs had met at a right angle. The right ureter, 32 cm. in length, took its origin from a long pelvis which lay nearly in the middle of the vertical branch of the L; this pelvis lay behind the two main renal arteries, and in front of a third artery. The left ureter came from the hilus of the anterior surface, and was 37 cm. in length. The ureters opened into the bladder normally. The variety of solitary kidney taking place through the junction of both organs on one side, at the normal position for the kidney of that side, occurs in one out of 8,000 autopsies.

¹Tully Vaughan: "A case of single fused kidney," The N. Y. Med. Journal, 1897, 13, XL., p. 659.

²Albarran et Cottet: "Tuberculose rénale ascendante; Double uretère pour le rein gauche," Soc. anat., Mai, 1898. Anal. de mal. des org. gén-urin., 1899, 1.

6. A CASE OF ALBARRAN AND COTTET.¹ In a woman who died of general tuberculosis, and who had presented symptoms of genito-urinary tuberculosis for years, the left kidney was divided in halves, one normal, the other diseased. From this kidney took their origins a normal ureter, and a diseased ureter; both however were enclosed in one covering. *Both opened separately into the bladder.* At this point the diseased ureter's mucous membrane was tuberculous.

In this connection we also give three cases of solitary kidney where it was not stated how they appeared.

I. A CASE OF KRÖNLEIN'S² reported at the Berlin Surgical Congress, 1900, in which on account of a suspected kidney or ureter stone, without having any idea where it was situated, he performed an exploratory laparotomy and found that the right kidney was wholly absent. He then closed the abdomen, and went in extraperitoneally for the left kidney, but could not find a calculus. He feared to incise the kidney, and the patient died. The autopsy showed a stone 5-6 cm. below the origin of the ureter.

THE SECOND AND THIRD CASES were those of *Israel*,³ who in course of the discussion (Berlin Surgical Congress, 1900) announced that he had operated on two cases of solitary kidney, but had no further details to give.

Finally in the same category belong three further cases, in one of which at the autopsy, and in the two others, during the operation, it was found that the second kidney existed only in a rudimentary form, and no kidney parenchyma could be found.

1. THE FIRST CASE is one of Chrétien's.³ At the autopsy of a patient who died of tuberculosis, *the right kidney* was found

¹ Berliner klin. Wochenschrift, 1900, Nr. 19.

² *Ibidem.*

³ "Tumeur cystique du rein droit avec atrophie excessive du rein gauche," Soc. anat., 1895 (July). Ann. d. mal. des org. gén-urin., 1895, XI., p. 1009.

transformed into a cyst which extended from the diaphragm to the pelvis. The corresponding ureter was as thick as a thumb. The tumor weighed 10 lbs. A small remnant of kidney tissue occupied the posterior upper portion of the cyst. *The left kidney* could not at first be found, and it was only on following up the ureter from the bladder that *a body the size of a pea* was come upon which represented the left kidney. *The left ureter was of normal thickness.*

2. A CASE OF SPRINGORUM'S,¹ of a man 56 years old who for a long time had suffered from severe cystitis and hæmaturia. Some time before, the presence of a *normally secreting* right kidney had been established by cystoscopic examination by a specialist in urology. On the left side a diagnosis of probable carcinoma of the kidney was made, and a nephrectomy advised. On account of the feeble condition of the patient, the operation was put off, and eight days later the patient died. Autopsy: left large white kidney, on the right in place of the kidney was *a small loose mass of tissue which represented the rudiment of a kidney pelvis. No kidney tissue (parenchyma) was present*; the right ureter ended in a blind sac 10 cm. from the bladder.

3. A CASE OF POWER'S.² 36-year-old man entered the hospital with a history of having passed no urine for six days; no urine in the bladder. Very weak condition; the only abnormal thing being a certain amount of muscle spasm in the right half of the abdomen. *Incision made in the right side* where a small kidney was found: Acupuncture disclosed no stone. The ureter appeared free from obstruction. The next day, after hot baths, the patient passed some bloody urine, and soon after became cyanotic, and had an intermittent pulse. *Death* occurred in a short time. *The left kidney consisted of only a*

¹ Med. Ges. zu Magdeburg, 15 Dec., 1898. Münchener med. Wochenschrift, 1899, 8, p. 270.

² "A case of suppression of urine associated with a single kidney," Lancet, 1900, I., 25/26.

small amount of connective tissue. Left ureter permeable, but thin. Left renal arteries and veins absent. Right kidney smaller than normal, pelvis dilated. Capsule adherent, granulated, and congested, four small stones in the kidney pelvis, ureter permeable.

From these reported cases out of the first two groups, namely cases where one kidney is wholly absent, and those of horse-shoe kidney or total degeneration of the second kidney, let us see what conclusions we can establish which will have an influence on kidney surgery.

With regard to the first group, these are as a rule cases of *congenital failure* of one kidney, which in general has been observed more often on the left than on the right. It was seen twice as often in men as in women. Still one can draw no inference from this, because women come less often to autopsy than men.

The kidney blood vessels are regularly absent in these cases, only exceptionally were rudiments of them found. In the 232 cases (213 old cases and 19 cases here cited) *the ureter was absent in all but 17*, an important point. One cannot exclude the possibility that in those 17 cases remnants of the degenerated kidney were overlooked. In certain of the earlier cases it was reported that a ureteral opening was present in the bladder which was permeable for 1-2 cm.; further up the ureter was obliterated and like a band—in other cases instead of an opening, only a slight

depression was to be seen. In 74 of those cases it was expressly stated that on the side where the kidney was absent no trace of a ureter opening in the bladder was to be found. In 4, the single ureter opened into the middle of the bladder, and in two others, into a cyst lying under the bladder mucous membrane.

In the 19 cases given in more detail, it is especially noteworthy that *the ureter of the side in question was absent in twelve*. In six it cannot be made out from the report whether it was present or not, and in one (case 5) the ureter was in its normal position in the bladder, but permeable for only 1 cm.

Operations on the kidney were undertaken in 3 of these cases. No. 14, Houzel; No. 15, Verhoogen; No. 17, Schetelig. *In all three, death followed the operation in a short time.*

In regard to the second group, among the six cases reported of horse-shoe kidney and of adherent kidneys, the case of Vaughan No. 5 loses for us its significance. For although the patient died shortly after, the case was one of intestinal resection, and not an operation on the kidney, so that the cause of death cannot be attributed to the absence of a second kidney. And the same is true of case 6 (Albarran and Cottet) because the woman died of general tuberculosis, without having undergone an operation on the kidney.

We have left the first four cases. Socin (1), Braun (2), König (3), and Lotheisen (4). Braun and

Lotheisen's cases died immediately after or in consequence of the operation, while Socin's and König's cases survived. In all four, the horse-shoe kidney was only discovered during the operation. Krönlein's case also ended fatally, while we do not know the result in Israel's cases.

In the three cases of degenerated kidneys with only rudimentary remnants, the first (Chrétien's) died of tuberculosis; the second, that of Springorum, escaped an operative death because the operation was abandoned on account of the patient's condition, and the third case, Power's, died shortly after operation.

These few reported instances, which lay no claim to completeness, but are only chosen examples, prove that the question of the presence of a second kidney must be most earnestly weighed before every kidney operation. They show it to an even greater degree than appears here, because the frequency of death after an operation in cases of solitary kidneys is without doubt much greater than one would take for granted from the cases reported. This is due to the fact that a certain number of cases which die from kidney operations never come to autopsy, and that operators are more ready to report their good than their unfavorable results.

It is therefore certain that the mortality rate in kidney operations would be lower if we could be sure in such cases whether a solitary kidney were present or

not, and so comes the question: Are there means, and if so what are they, of diagnosing this condition? Let us consider the methods of examination for this purpose.

1. *Inspection.*—In cases of thin patients, Le Dentu¹ believes that an abnormally small filling out of the lumbar fossa points to the absence of a kidney on that side. That is certainly possible, but who would be willing to make a diagnosis on such evidence?

It seems to us more rational not to limit the inspection to the kidney region, but to have it include the whole genito-urinary system. An absence or abnormality of one or more of the palpable and visible genital organs; as for example, monorchismus, cryptorchismus, epispadias, hypospadias, vaginal and uterine anomalies are often combined with absence of a kidney. And so in such cases one is justified in saying that the presence of any such abnormality makes us especially think of the possibility of one kidney being absent.

2. *Percussion of the kidney region is a method which, according to our opinion and experience, has even less to recommend it.* There are certain authors, as Gerhardt, Zülzer and F. Müller, who believe a kidney can be defined by percussion. Still we agree with Pansch² who denies the worth of kidney percussion,

¹ Affections chirurgicales des reins," Paris, 1899.

² Archiv für Anat. u. Physiol., 1876, Nr. 3.

and Küster¹ expresses it mildly when he says that one can never be sure from the percussion whether a kidney of normal size is present on that side or not.

3. *Palpation deserves a somewhat higher rating*, considered of course only in this connection, for palpation of the kidneys in general is a quite important method of examination. It can be performed in various ways, one of which is the *bimanual palpation with the patient lying on his back* with his legs slightly flexed on the thighs, and with the aid of deep inspirations (Tuffier, Litten). If the patient holds his abdominal wall rigid, palpation will give no information; he must then be made to relax either in a warm bath, or through narcosis (Lennhoff). In this connection Guyon employs his method of *renal ballotement*, in which by means of short blows on the lumbar region, the kidney is forced towards the anterior abdominal wall, where it can be felt by the hand of the examiner laid flat on the surface. Morris recommends having the patients lie on their normal side with legs drawn up, and the body twisted over a little to the abdominal side. In this position the intestines fall forward, the lumbar region sinks forward and down a little, and on that account becomes better palpable. Israel recommends the same method.

Finally Glénard recommends his "procédé de pouce." If one wishes to examine the right kidney,

¹Chirurgie der Nieren.

the left hand grasps the flank, and vice versa with the other kidney. The fingers lie in the lumbar region, and the thumbs on the anterior surface of the body in the kidney region. The lumbar region is pressed forward by the fingers so that the kidneys are forced against the hand laid on the anterior side, and thus can be felt.

We will not discuss here what is the best method of palpation, but simply state that in one case this method, in another that, will give the best results. However useful this procedure of systematic palpation may be in cases of pathologically enlarged and displaced, and unusually hard kidneys, or in those with altered surface formation, and however often one may get good results in positive cases, still it is certain that *in negative cases, that is, where one cannot feel the kidney, it is impossible to declare that no kidney is present: for there are kidneys which cannot be palpated at all.* These occur in persons with fat abdominal walls, and also in thin patients if the kidneys lie under the ribs, and even on deep inspiration do not descend low enough to be palpable. Accordingly palpation can help in solving the question only in exceptional cases.

4. *Actinography (Roentgen rays), one of the most modern of methods of investigation, gives us even less information.* Since photography of cases where the kidneys are present gives no visible shadow, we can put no dependence on the X-ray plate. With the pres-

ent technique, examination by X-rays gives only seldom, as for example in the presence of large calculi of certain sorts, a definite picture. And so in cases where the photograph shows nothing remarkable, we are by no means justified in supposing nothing abnormal is present.

5. *Cystoscopy* is a method of examination whose value is to-day so generally known that we need say nothing further of it. But its importance in deciding our present question is not so undisputed. With few exceptions we can examine the bladder so thoroughly with the cystoscope as to be able to say whether ureter openings are present or not, and by watching them we can generally tell whether they functionate or not, that is, whether fluid comes from them.

But we must be very careful the way we turn this to account. We will leave out of the question the few cases where ureter openings which are present cannot be seen on account of difficult circumstances. This can occur in the presence of contracted bladder, with cystitis accompanied by severe swelling of the mucous membrane, with tumors, with hypertrophy of the prostate or from the presence of ridges which cover the openings of the ureters. In many cases an opening of a diverticulum or a crease in the bladder mucous membrane is not to be differentiated from a ureter mouth.

Accordingly just as the impossibility of seeing the

ureter openings in every case is no proof of the absence of the ureters, so on the other hand the presence of a ureter opening is not always an indication that a kidney is present on that side. For we must remember that two ureters can originate from the same kidney, and that a ureter opening may be present while the kidney exists only in rudimentary form. If we wait for the contraction of the ureter, our doubt will in many cases be cleared up; for generally one can surely and clearly see how the urine spurts out of the ureter, still we must bear in mind a source of error which may deceive even the most experienced observer. The ureter may contract, and give one the impression of fluid spurting from it, while as a matter of fact nothing of the sort happened. The explanation of this lies in the fact that at the contraction of the ureter, the bladder wall and with it the fluid in the bladder is set in motion. This movement can easily be taken for an eddy which is very much like the one which seems to come out of the ureter when urine enters the bladder.

When one takes these facts into account, cystoscopy will often give us information as to whether two kidneys are present or only one. The reports of the cases of congenital kidney defect have shown us that in almost all these, the ureter of the corresponding side was absent. *As to whether only a rudimentary kidney is present without any secreting parenchyma, that is a question which cystoscopy can seldom answer for the reasons given.*

6. *Catheterization of the ureters*, which has already won for itself in scientific and practical medicine a lasting position, *is the one of all the methods thus far described which will come nearest to accomplishing our purpose*, although it, too, cannot meet the needs of every case.

We must first understand that this procedure cannot always be carried out. Certain conditions make it impossible. Contracted bladders, and those cases already mentioned when the ureter openings cannot be seen. If this method can be followed, we can with certain exceptions tell to a certainty, whether a second kidney or at least one which secretes urine, is present.

We saw that in the cases of congenital renal defect, the ureter was also generally absent. But if present, it is not always permeable to a catheter. Thus in cases where the kidney is totally degenerated, so that no urine is excreted, even if one catheterize the ureter he will not be able to get any urine, a fact which we have observed in several cases.

However we must also consider in this connection that often for a long time no urine flows from the ureter of a normal kidney. This can happen for various reasons. Spasms of the ureter occur, the eye of the catheter may have buried itself in the mucous membrane of the ureter, the catheter may be stopped up, the ureter may be compressed by neighboring organs, and so forth. These incidents are easily recognized

by the experienced, and do not occur every time. Only when the urine fails to flow through the catheter which has been introduced, in repeated sittings, is one justified in concluding that nothing is secreted by this kidney. It is evident that this method of examination must be foregone in cases where an operation is urgent and where one cannot wait for repeated examinations.

For another reason also the catheterization of ureters gives us no absolute certainty in the decision of the question as to the presence of a second kidney, because two ureters may originate from one kidney. This, however, as we have seen in cases I. and II., is a very extreme rarity, so we may say with very few exceptions, that catheterization of the ureters can decide this point.

We will here touch upon two objections which can and have been made to this practice.

a. That it is dangerous. We must answer this objection by saying that it is not grounded on experience. For the very ones who raised this point had not tried the method, at least at the time they expressed this opinion. The few reported cases where infection followed the introduction of the catheter into one ureter after it had been withdrawn from the other, have not been properly substantiated. The possibility of the appearance of infection occasionally cannot and will not be denied, but against these more theoretical opin-

ions, stands the testimony of authors who have had a large amount of personal experience in this direction. Albarran, Pasteau, Kümmel, Stockmann, we ourselves, and many others, have become convinced from many hundred examinations that the procedure is not harmful when it is carefully carried out by an experienced person. It would be going out of our way too far to explain in detail here how it can be performed most safely.

We will only say this, that the catheterization of the ureters must be carried out strictly according to indications, that it generally suffices when the disease is supposed to be unilateral, to catheterize only the diseased ureter, and to collect the urine from the other from the previously emptied bladder. Although we in our cases later to be reported have generally done differently, that is, have catheterized both ureters, we thought it was a question of settling fundamental principles of general application, where it was desirable to avoid every source of error. Such sources are present, although in small degree, when one catheter lies in the bladder. But since this practical knowledge has been once for all obtained, it is a good rule to observe when possible, to introduce the catheter only on the diseased side. In case this does not answer, for reasons which we will not go into here, or if one is able, as occasionally happens, to catheterize only the normal side, then one should have no hesitation in doing so.

b. The method is difficult and not adaptable for the majority of operators. This is also an objection which has not a shadow of reason. When a surgeon intends to operate on a kidney, it is his custom to solve the question as to the presence of a second kidney by all the means science has furnished us. If the question cannot be decided in any other way, then he must use this method, or if he cannot, he must call in someone else who can do it for him.

There is also another method by which we can, although not always yet still often, tell with certainty whether a second kidney is present or not, and that is—

7. The palpation or feeling of the second kidney after a surgical operation. This is done in various ways. One can perform a laparotomy and convince oneself whether a second kidney is present, and whether it is of normal size and consistency. In case this is so, the abdomen is to be closed, and the kidney to be operated on is gone in upon extraperitoneally.

Kocher exposes the kidney to be operated upon, opens laterally from it the peritoneum, introduces his hand to see if the second kidney is present, and after closing the abdominal cavity, operates extraperitoneally.

Finally, authors have advised cutting down upon each kidney extraperitoneally by a lumbar incision, and, after palpating them, either closing the incision or operating further.

There are two objections to this method of examination which may be raised.

1. *It is not without danger*, and the greatest surgeon would not claim that such an operation, undertaken for diagnostic purposes, could be without disadvantage to the patient, especially in the case of an already weakened anæmic person. Küster hits the nail on the head on this point when he says: "We must hold fast to one rule, that one should avoid bloody operations for diagnostic purposes as long as it is possible to arrive at a conclusion in other ways."

2. *But still more important in our eyes is the second objection, that one doesn't accomplish, even with these operations, what one wishes.* After an incision and the following palpation we may well say that a second kidney is present, and that it has such and such a size and consistency—but more we cannot say. There are cases known, moreover, where an apparently normal second kidney was nothing more than a lump of fat, an atheromatous cyst, or a mass of fat enclosing a stone—conditions which have the same significance as the absence of a kidney. Zondeck¹ demonstrated a preparation in the Berliner medicinischen Gesellschaft where a kidney was wholly replaced by fat which was deposited about some calculi.

Poncin² had an instructive case in this respect: A woman of 60 had pus, albumen, and casts in her urine; fever, an

¹Verhandlungsberichte der Berliner med. Gesell., 1898, p. 213.

²Lyon méd., 1899, LI., p. 562.

apparent kidney tumor. Diagnosis: "Pyelonephritis." Operation showed a large branched stone in the pelvis and a small stone in the parenchyma. *Death. The autopsy disclosed a still considerable amount of parenchyma in the operated kidney, which was badly torn in the manipulations in removing the stone. The other kidney showed complete sclerotic atrophy, and perinephritis lipomatosa; it was only a mass of fat, somewhat larger than the kidney, which enclosed a stone.*

A case fully as important is one by *Sendler*.¹ The *right tuberculously degenerated kidney was removed* from a 30-year-old woman, as it was believed that the urine, which was at times normal and clear, came from the apparently palpable normal kidney. *The left kidney was however in a cystic atheromatous condition.* Neither cystoscopy nor catheterization of the ureters was undertaken.

Surgical operations performed for diagnostic purposes give us information as to whether a kidney is present or not, but do not always prove that it is a secreting organ, which is the thing we wish to know.

To sum up then, all available and described methods of investigation should be employed in deciding whether a second secreting kidney is present. At times one alone, at times several together will solve the problem: *surest of all methods is cystoscopy in combination with catheterization of the ureters:* and in the rarest exceptions, where an operation is urgently indicated, and other methods of investigation which could throw light on the matter would use too much time, a surgical operation for diagnostic purposes is appropriate.

¹ Münchener med. Wochenschrift, 5 Juni, 1898.

These considerations lead us to the essential point of the whole matter, to those cases included under group III. where it is evident that in surgical operations on the kidney, *one must not only know whether a second secreting organ is present or not, but one must also calculate whether this second kidney performs its function in such a normal manner as to be able to take upon itself the work of the other, if the latter is removed.* We shall see from certain examples from the literature on the subject how important a rôle this circumstance plays in the results of renal surgery.

1. MERCKEL (NÜRNBERG). [Bayerisches ärztl. Intelligenzblatt, 1879, 21.]

A woman, 28, noticed lately a tumor in her abdomen which caused her great pain in walking about. On examination of the very poorly nourished patient, a tumor was found which could be pressed out from the right side toward the linea alba. Diagnosis: organically diseased movable kidney. Operation 24 Oct., 1879. Incision in the linea alba—pedicle ligated en masse. *Steatosis of right kidney.* After the operation patient passed little urine, *and died on the fifth day of uræmia.* The left kidney also showed fatty degeneration.

2. RAFFA (ROVIGO). [Centralblatt für Chirurgie, 1881. Citat. aus Gaz. med. Ital., 1881, 19/20.]

Woman, 26, had for last sixteen months cloudy urine which contained foul-smelling pus. *On the right* above the navel was a movable tender swelling the size of a hen's egg. Operation: Lumbar incision, the kidney was entirely removed, and the pedicle, as thick as a finger, secured by two silk ligatures; slight hemorrhage; on the eighth day the ligatures were dis-

charged and the fistula remained permanent. *In four months, the patient died of tuberculosis. Cheesy foci were found in the left kidney.*

3. LÜCKE. [Deutsche Zeitschrift für Chirurgie, 1881, XV., p. 519.]

A man of 60 had for a long time noticed a hard mass in his lower abdomen. *In the right side* was found a hard, smooth, somewhat tender tumor; urine normal. Diagnosis: sarcoma of the kidney. Operation Aug. 1, 1880: Incision in the linea alba. The movable tumor was shelled out by the hands, during which it was torn open. An enormous venous hemorrhage occurred, which after some minutes was checked by compression with sponges. Ligature of vessels, compress bandage. Diarrhoea set in accompanied by anuria. *Death from shock on the fourth day. The right kidney was carcinomatous, the left kidney partially contracted with cystic degeneration.* The renal vein was torn and contained a carcinomatous thrombus. A 15 cm. tear in the vena cava was occluded by a thrombus.

4. LANGE. [N. Y. Med. Record, XVIII., No. 6.]

The woman, 47, had had symptoms for three years. Up to a short time ago the urine had been purulent, and then suddenly became clear. *In the right hypochondrium* behind the intestines was a tumor the size of a child's head. Patient had very high fever. Diagnosis: Right pyonephrosis, left kidney normal. Operation 24 March, 1880. Incision made from the edge of the sacrolumbalis downward and inward to the rectus abdominis. The upper portion of the kidney was tightly adherent to the neighboring tissues. Pedicle tied off in four portions—slight hemorrhage. *Total anuria set in after the operation, and the patient died in deep coma 84 hours later.* The extirpated kidney had a circumference double the normal size, and contained many cysts (abscesses) which in turn held calculi. *The left kidney was totally degenerated, apparently from an old pyelitis. Left ureter obliterated.*

5. KÜSTER. ["Ueber die Sackniere," Deutsche med. Wochenschrift, 1888, 21, p. 418.]

Ida S., 28, from Gotha, was sent in on March 27, 1887, with a diagnosis of *double hydronephrosis with calculi on the left*. For the last five years she had here and there dull pains in the left lower abdomen, and occasionally rheumatic pains in the left lumbar region, from which they radiated. For the last 2½ years, the patient had noticed her urine was cloudy, and in August, 1886, in Wildungen, a severe attack of pain lasting five days took place, located in the left lower abdominal region. Since then the urine has been much more cloudy, and has contained sediment and light bloody streaks, although no severe hemorrhage ever took place.

The freshly passed urine is now cloudy, and floating about in it are coarse and fine particles; on filtration the heat test shows a visible although translucent cloudiness which does not disappear on the addition of nitric acid. No sugar. Microscopical examination of the sediment shows besides a large number of leucocytes, a considerable amount of large irregular transparent pavement epithelium, some of which is provided with a long process or continuation. No casts. The particles described above consist of mucus, leucocytes and epithelium.

The right kidney lies in a normal position, and shows obscure fluctuation. Puncture negative. The left kidney region is taken up by a clearly fluctuating tumor the size of three fists, which extends downward somewhat below the anterior superior spinous process, and in front of which intestinal tympany is everywhere to be heard. The trocar as soon as introduced detected a stone. At the nephrolithotomy, a large amount of dirty urine came out of the pelvis of the kidney, and a large branched calculus was found which could only be removed after being broken. Many fragments of calculi were removed with a spoon. Kidney was flushed out, its parenchyma being found reduced to a few mm. in thickness. *Three days later death occurred in uræmic coma.*

6. EUGEN COHN. [Vorstellung eines seltenen Falles von Hydronephrose. Freie Vereinigung der Chirurgen Berlins, 3 Dec., 1888. Berliner klin. Wochenschrift, 1892.]

Woman, 30, one child, one abortion. In October, 1886, after lifting a heavy object, she felt a painful stitch in the *right hypochondrium*. Since that time she has been obliged to urinate more frequently, and has at times noticed blood in her urine. Later a swelling appeared below the right hypochondrium, accompanied at intervals by severe pains which radiated into the back. At the time of her admission into the hospital at Freidrichshain, July, 1887, there was on the right side a large kidney tumor with smooth surface; no fluctuation.

Urine rather cloudy, 2,000-3,000 c.c. in 23 hours. After patient's going to bed, the pains disappeared, but recurred later, as well as blood in the urine. On the 21st Jan., 1888, a *fistula in the kidney pelvis* was established in the axillary line. Since that time all the urine has been discharged from it, none going into the bladder. After the fistula grew smaller, some urine passed into the bladder, but the tumor again began to swell accompanied by fever, so that permanent drainage of the pelvis of the kidney has since then been necessary. Apparently this was a rare case of congenital absence or *total atrophy of the left kidney*.

7. HERCZEL. [Beiträge zur klin. Chir., 1890, VI., p. 489. BRAUN, Deutsche med. Wochenschrift, Nachtrag 13, Aug., 1881, p. 449.]

Patient A. B., 33, upon whom a right nephrectomy was performed through a lumbar incision on account of *hydronephrosis*, died on the day after the operation. The left kidney was wholly atrophied. It was an organ 4 cm. long by 1-2.5 cm. wide, flat, covered by a layer of connective tissue which was thin, but exceedingly rich in blood-vessels. There was no secreting tissue present. From the inner side of the organ the ureter took its origin from the obliterated kidney pelvis, and was 30 cm. in length, of which the first 4 cm. were fully closed, but from there on to the bladder it was permeable. Its opening into the bladder however was smaller, and the ureteral papilla was less developed than on the right side.

8. HERCZEL. ["Ueber Nierenexstirpation," *Klin. Beitr. z. Chir.*, 1890, VI., p. 362.]

Woman, 43, who for 17½ years had suffered from *left-sided attacks of renal colic*, with periodic passage of pus from the bladder, albuminuria, etc. On opening up the kidney on 21st June, 1889, an abscess the size of a hazel-nut was immediately met with on the posterior surface near the middle of the convex border. On opening this, a cavity the size of a walnut (dilated calyx) was found, in which a wedge-shaped calculus was impacted. Packing following extraction. *A nephrotomy only was attempted, on account of a well-grounded suspicion of amyloid of the right kidney. Death occurred on 16 July.*

9. HERCZEL. [*Beiträge z. klin. Chir.*, 1890, VI., p. 502.]

Paul D., 36, city official, had noticed six years before on several occasions a bloody tinge in his urine. During the winter 1879-80, the passage of clotted blood occurred, accompanied by great pain. In April, 1881, *the left kidney was found enlarged*, and since then has steadily gained in size. Patient is emaciated with jaundice-tinged skin. Lower left thorax distended by a tumor the size of a man's head, which originating from the left hypochondrium, extends downwards to the crest of the ilium, inwards to the navel, and in the epigastrium 2-3 fingers' breadths beyond the linea alba. It is smooth with projecting areas, hard, non-fluctuant, and presents a protruding portion between the axillary and mammillary lines, which presses the skin 4-5 cm. before it below the costal border: on deep inspiration it retreats somewhat. The urine contains much albumen, many hyaline and granular casts, some with epithelial cells.

Operation, 14 Feb., 1885. After making an abdominal incision, the tumor was removed from its adhesions and rolled forward. In doing this the kidney pelvis was torn, and seen to be filled with cheesy material. Vessels tied off separately, and another ligature placed around the whole pedicle. No ureter to be found. The tumor was of great size. Patient in good

condition for a few days after operation, then dryness in the mouth, irritative cough, sleeplessness, œdema of the extremities, diarrhœa, but never fever. *Death* on Feb. 20. After the operation the urine was sufficient in quantity, and contained less albumen and casts than before.

Autopsy: Left renal vein filled with a large thrombus which extended nearly to the point where it crossed the aorta, the same true of the left renal artery. Normal condition of right renal vessels. *Right kidney contained several superficial cysts, and was pale, shining, and gave the typical iodine reaction.*

10. HERCZEL. ["Ueber Nierenexstirpation," Beitr. zur klin. Chir., 1890, VI., p. 361.]

An unmarried woman of 38, with congenital ectopia vesicæ. For thirty years she had suffered from periodic attacks of severe pain in the left flank, accompanied by chills; the urine was sometimes absent for half a day, and was often cloudy and bloody with small concrements. On the 25 July, 1888, on account of anuria for 8 days, *a tumor in the right kidney region* was aspirated by Prof. Czerny, followed by the evacuation of foul pus. In the right half of the abdomen was a round rather fluctuant tumor, as large as a man's head, extending somewhat beyond the median line: on the left side a smaller tumor. *Catheterization of the ureters during narcosis yielded no fluid.* Right nephrotomy gave 1½ liters of a fluid resembling urine. The examining finger passed through the perirenal fat which was infiltrated with urine, and through the greatly thinned kidney parenchyma, which was in places broken through, into the kidney pelvis. This was greatly dilated and filled with concrements, and about a dozen calculi the size of beans and small nuts besides much detritus were removed. *Death followed 27 hours after the operation.* The right kidney pelvis showed the presence of many more calculi, the ureter was shut off. *Left kidney totally atrophied*—pelvis widely dilated and filled with concrements which lay over the opening of the ureter.

11. HERCZEL. ["Ueber Nierenexstirpation," Beitr. zur klin. Chir., 1890, VI., p. 360.]

Woman, 39, greatly emaciated, had suffered for years from left-sided kidney symptoms. Much pus and albumen in the urine. *In left lumbar region fluctuating tumor the size of two fists.* 25 July, 1882, lumbar incision, opening of kidney with evacuation of a large amount of foul matter. There were many abscess cavities separated by thin portions of degenerated kidney tissue. In the pelvis of the kidney was a large calculus firmly embedded (4, 2, 1 cm.) which was removed in four pieces by spoon and tongs. Disinfection, packing with iodoform gauze. The great cavity discharged a large amount of pus, part of which found its way into the bladder, and soon in spite of most careful drainage and flushing, retention of secretion occurred, accompanied by slight chills. Wound became oedematous, general anasarca. At the end of September, *hyaline and granular casts appeared in the urine, which pointed to disease of the other kidney.* Later dry pleurisy, peritonitis, death four months after operation.

Autopsy: *Parenchymatous nephritis of right kidney*, severe grade of pyelitis on the left, dilatation of kidney pelvis, contracted kidney.

12. HERCZEL. ["Ueber Nierenexstirpation," Beiträge zur klin. Chir., 1890, VI., p. 343.]

L. S., male, 24, previously had had pelvic inflammation, gonorrhea, and gleet: *at 21, pains in left kidney region*; urine at times very cloudy, alkaline, then again a light straw yellow. No blood. For the last year and a half, patient has been worse, pains constant. Administration of benzoic acid, and a course of treatment at Wildungen produced no improvement. No calculus in the bladder. Urine: 1200-1300 c.c., 1016-1018 Sp. Gr., slightly alkaline, 1/12-1/15 per cent. albumen; large amount of leucocytes, many triple phosphate crystals, occasional hyaline casts, smooth epithelium, detritus, no tubercle bacilli. Patient very anæmic with strong abdominal

muscular spasm. In narcosis one feels clearly deep down in the lower kidney region a mass descending on deep inspiration. In the knee-elbow position, only a very slight difference in percussion between the left and right sides. *Operation on 19 June, 1889*, with the intention of doing a nephrotomy. The *left* kidney was difficult to reach by a diagonal incision, on account of its rather high position, and the amount of fat pressing upon it, and on attempting to isolate the kidney pelvis a large renal artery came into view lying behind it. It seemed too unsafe to try to free this, so the whole kidney was enucleated from its capsule, and after enlarging the skin incision downward and inward, the organ was drawn out. It was then seen that the upper portion of the kidney, which had, in all, three lobes, was closely adherent to the neighboring tissues, and stuck to the capsule by a pseudo-membrane. Since too there were several hemorrhagic spots on the organ, its pedicle was developed, tied off with an elastic ligature, and the whole mass removed. Disinfection with sublimate, and packing with iodoform gauze wicks. The middle and lower portion of the extirpated kidney was enlarged, while the upper portion was posteriorly greatly flattened, and anteriorly rough, uneven, and strewn with white points as large as millet-seeds, between which the parenchyma was atrophic and the cortical substance reduced in amount. A similar patch half the size of a quarter extended out from the hilus between the middle and lower portions of the kidney. The pelvis and calices were moderately dilated and thickened, in the upper half with red flecks, and normal below. On section the border between the flattened pyramids and the cortical substance was effaced, and the surface of the organ was covered with hemorrhagic areas which on section were seen to extend in as far as the pyramids.

The patient rallied poorly from the operation: on the 21st he slept a great deal, respiration 12 to the minute: the minimal amount of urine (110 c.c., 20 c.c.) directed suspicion to disease of the other kidney: purging of bowels, caffein, natr.

salicyl. Next day patient slept almost continuously, slow respiration (10-20), moist tongue, much thirst and perspiration, mind clear, very little urine (10, 10, 64 c.c.). On the 26th restlessness, subsultus in right facialis and right arm. Bowels moved, no cedema, 120 c.c. of albuminous urine. *Death on June 27.*

Autopsy: In this case also the right kidney was absent, in its place a *membraneous sac* in the upper pelvis, the upper end of which was scalloped like kidney calices. A ureter as thick as a finger led from this into the bladder. Somewhat external to this opening, the little finger could be passed through a round hole into a diverticulum of the bladder, which was as large as a medium-sized apple, and extended to the linea innominata passing in its course behind the large intestine. This diverticulum had no connection with the sac described above. The bladder held a small amount of purulent urine, its mucous membrane was dirty and somewhat discolored. *Absence of the right kidney, and its transformation into a membranous sac which was pushed downward.*

13. M. WOLKOWITZ (Kiew). [Chirurgische Jahreszeitschrift, 1895, II. Moskau. Internat. Centralblatt, f. d. Krankh. der Harnorgane, VI., 1895, p. 332.]

Nephrotomy—*other kidney degenerated.*

14. HILDEBRANDT. [Deutsche Zeitschrift f. Chir., 1895, p. 97.]

In the case described, the operation was discontinued as soon as it was known that both kidneys were cystically degenerated. *Death on the fifth day after only a nephrotomy, with symptoms of uræmia.* The patient had certainly only a small amount of functioning parenchyma in his kidneys, still it had answered the purpose up to the operation—after that, the excretion of urine ceased.

15. HILDEBRANDT. [Deutsche Zeitschrift für Chirurgie, 1895, p. 114.]

A man of 22 had had trouble with his kidney for four years, and a large amount of blood in his urine. For the last six

months he had suffered from *pains in his left kidney* following a kick in that region. The tumor the size of a kidney, lying under the surface of the abdomen above the anterior superior spine, was removed transperitoneally, after having evacuated by a trocar 800 c.c. of a white purulent fluid. *The patient died four weeks later. The right kidney was of approximately normal size, with smooth surface, parenchyma reduced to about 1 cm. in width, pelvis and calices greatly dilated, with smooth walls. In the pelvis was a smooth stone as large as a pea, of hard consistency: ureter not dilated, catarrh of the bladder.* The extirpated kidney consisted of a very large hydronephrotic sac, all the calices very widely dilated as well as the pelvis, to such a degree that the kidney substance in places was reduced to the thickness of paper, and its thickest portion was only $2/3$ cm. The ureter was also greatly widened, so that its lumen would admit a thick pencil. In its first portion was a black blood thrombus, about $1\frac{1}{2}$ cm. in length, and tightly adherent to the wall.

16. STEINTHAL. [Stuttgarter chir.-gyn. Vereinigung, 1895, 13. Münchener med. Wochenschrift, 1896, 16.]

The *right kidney* was removed from a young girl for tuberculosis, after a clear fluid had been seen with a cystoscope to be discharged from the left ureter. *The patient died on the next day. In place of a left kidney was a sac full of clear fluid.*

17. LOTHEISEN. [Arch. f. klin. Chir., 1896, p. 731. Ein Beitrag zur Chirurgie der Nieren.]

In a 39-year-old man, who was an invalid, there developed with symptoms of colic pains and hæmaturia during the last three years, a *tumor on the right side, as large as a child's head, hard, and irregular.* At present rapid emaciation. Lumbar nephrectomy, *death in 14 days.* Autopsy showed metastases in the brain, pleura, and mediastinum, *and a carcinomatous node in the left kidney.*

18. LOTHEISEN. ["Ein Beitrag zur Chirurgie der Nieren," Arch. f. klin. Chir., 1896, p. 741.]

Billroth's case. The left ureter of a 48-year-old woman was tied off during an ovariectomy, resulting in an abdominal wall ureteral fistula. Nine months later a *nephrectomy (left) was done through a lumbar incision*: followed in 11 days by death. The other kidney showed *parenchymatous nephritis* (question of carbolic acid poisoning).

19. LOTHEISEN. ["Ein Beitrag zur Chirurgie der Nieren," Arch. für klin. Chir., 1896, p. 763.]

A woman of 40 had had for the last eleven years a pelvic tumor (see *Wölfler*, Arch. f. klin. Chir., 21). This had grown slowly, suddenly disappeared, later to reappear. With a diagnosis of *cyst of right kidney* a laparotomy was performed. Puncture evacuated 6 liters of a brown fluid, kidney incised, sewed to the abdominal wall and drained. *Eleven days later death from uræmia. The second kidney showed parenchymatous and fatty degeneration* (carbolic acid poisoning?).

20. WANTSCHER. [Beitrag zur Ätiologie und zur chirurgischen Behandlung acuter eiteriger Pyelonephritis," Inaug.-Diss. Greifswald, 1896.]

A woman of 24 died eight days after a *nephrotomy*. Autopsy showed double *nephrolithiasis*; the *right kidney substance was practically all gone*. In the ureter was a calculus about 1 cm. long. *The left kidney had lost its function in the same way on account of a stone in the ureter.*

21. BENECKE. ["Freie Vereinigung Berliner Chirurgen," 13 Juli, 1896, Berliner klin. Wochenschr., 1897, p. 84.]

A case of so-called struma supra-renalís of the right kidney in a man of 51, who for the last year had become greatly emaciated, and who at times had a large amount of blood in his urine. Even before this a large *tumor of the right kidney had been discovered*, an operation advised, but refused. In the meantime the tumor had grown larger, and more pressing symptoms had set in. At times there was retention of urine, the urine contained much blood, the emaciation had advanced, and the patient was anæmic and had dyspnoea. At the extirpa-

tion of the kidney which was accomplished with difficulty, many retroperitoneal glands appeared, a number of which were adherent to the cava, and had to be left behind. *Death occurred on the next day in a sudden collapse. The autopsy showed cystic degeneration and hydronephrosis of the other kidney, and death was clearly due to its insufficiency. There were metastases in the left supra-renal body, the retroperitoneal glands, and the lungs.*

22. PINNER. [Arch. für klin. Chir., 1897, p. 447.]

Case 1. Extirpation of an enlarged tuberculous *left kidney, followed by anuria and death in five days.* At the autopsy the *right kidney was found transformed into a cavity filled with pus.* No cystoscopy, no estimation of the urea.

23. DIEDERICH. [Soc. Belge de chir. Ann., 15 April, 1898, 1. Quelques observations de chirurgie rénale.]

A woman of 52 with tuberculosis of the *left kidney* and bladder, died with *uræmic symptoms—the right kidney was degenerated.*

24. ALBERTIN. ["Anurie calculeuse et rein unique," Ann. des mal. des organ. génito-urin., 1898, IV.]

At a nephrotomy on the *left* side, the calculus could not be removed, and so the wound was left open. *Death in two days.* The *right kidney* was only as large as an almond, like a shell around three small stones. The right ureter opening very small, and the ureter permeable only for a very small sound.

25. LITTEN. [Berliner med. Ges., 19 Oct., 1898. Berliner klin. Wochenschr., 31 Oct., 1898, No. 44, p. 983.]

A woman who had had symptoms for a long time, showed in the *right hypochondrium a large fluctuating tumor which originated from the kidney.* The urine contained much tenacious pus, although it formerly had been clear, and almost without albumen; $1\frac{1}{2}$ liters in amount—1012 Sp. Gr., and always without morphological elements. The left kidney was not palpable, and was supposed to be normal and to be the real secreting organ, as the pus was ascribed to the right kid-

ney. Professor Körte who was called in consultation agreed to an extirpation: pus was said to have been seen with the cystoscope welling out of the right ureter; the left ureter could not be brought into focus, but clear urine was claimed to have been seen before this coming from it. The operation showed a stone in the right kidney which was a cast of the pelvis with prolongations into all the calices: the kidney was removed. *Death in coma followed on the sixth day after operation.* Autopsy: *Left kidney transformed into a membranous sac, in which only slight traces of kidney parenchyma were preserved. Left ureter wholly destroyed from the kidney to the bladder: calculi in the kidney.*

26. R. F. WEIR. [Med. News, 1898. Centralblatt f. Harnorgane, 1898, 6.]

Nephrotomy for kidney abscess of traumatic origin. Death after four days on account of interstitial *nephritis of the other kidney.*

27. AMRAY. [Société anatom., 14 Juni, 1899. Anurie calculeuse; destruction du rein du côté apposé à l'oblitération urétérale.]

Amray demonstrated the kidney of a patient who in spite of a nephrotomy, died of anuria caused by renal calculi. The ureter on the side of the operation was wholly stopped up near its entrance into the bladder by a mass of kidney detritus. The kidney of the other side was atrophied on account of a hydronephrosis due to calculi.

28. MARCILLE. [Société anatom., 14 Juni, 1899. Anurie calculeuse: lésions renales doubles.]

The kidney demonstrated by Marcille came from a patient on whom a *nephrotomy* was done on account of anuria of five days' standing: *the patient lived two months after the operation.* The kidney operated on was hypertrophied and showed the symptoms of a diffuse nephritis. *The kidney on the other side was atrophic; the pelvis filled with an impacted stone, no lumen discoverable in the ureter.*

29. KÖNIG-PELS-LENSDEN. ["Die Tuberculose der Niere," Deutsche Zeitschrift f. Chir., 1900, LV., p. 9, Beobachtung 4.]

Apparently well woman, six children, peritonitis four years ago. For the last year and a half painful tenesmus with pains on the left side in the bladder and kidney. Urine acid, cloudy, normal amount, many round cells, epithelial and caudate cells, little albumen, no tubercle bacilli. *In the left side of the abdomen* in the kidney region is a tense, elastic, very sensitive tumor, the size of an ostrich's egg. From it down to the bladder a band can be followed as thick as one's thumb. Emaciation, catarrh of both lung apices, no fever. 22 Aug., 1895, *nephrectomy* with König's right-angled lumbo-abdominal incision. Numerous adhesions of the kidney to the fat capsule and peritoneum, and contracted tissue about the pedicle, made the operation very difficult. The ureter which was filled with cheesy material was resected 5 cm. further down in apparently normal limits, and its lumen sewed over with serosa. The kidney was enlarged to twice its normal size, and contained numerous cheesy foci, cheesy material in the kidney pelvis and ureter, and on their walls many tubercles. The day of the operation 50 c.c. of purulent urine was passed, then anuria set in. On Aug. 24 *continuous twitchings of the hands, on the next day general convulsions, vomiting, etc., death.* Autopsy: The stump of the ureter of the left kidney was diseased down to the bladder, around its mouth tubercle nodes. *The right kidney was not as large as a duck's egg.* Its vessels were of minimal size, and the ureter had hardly any calibre. Old cheesy foci took up most of the organ. Orth supposed from the small size of the vessels that it was a *case of congenital atrophy.*

When one looks over these cases which represent only a small selection from the literature of the last years, he will no longer doubt THAT DOUBLE KIDNEY

DISEASE MAKES AN OPERATION VERY DANGEROUS. We will leave out of the consideration cases 6 and 13, as not completely enough observed: then there remain 16 nephrectomies and 11 nephrotomies. *Of the former, all but one case died in a short time, most of them a few days after operation. The one case died after four months. Of the eleven nephrotomies, 9 died very soon, the tenth 2 months, and the eleventh 4 months after operation.*

The operations, nephrectomies and nephrotomies, were performed for steatosis, hydronephrosis, pyonephrosis, tuberculosis, calculi, and tumors of the kidneys. In a large number of cases (7) the second kidney was degenerated; pressure atrophy existed in four; in four more the kidneys were transformed into a cystic mass; in three parenchymatous, and in one interstitial nephritis was present; and in the remaining cases tumor metastases, tuberculous and amyloid processes, and calculi were found in the organ not operated on.

If then the causal connection between deaths in cases following kidney operations and disease or incompetency of the sister organ has been made clear, we have the following questions to lay before us.

1. *What influence would it have on kidney surgery and its results, if we were able before the operation to recognize disease and the functional condition of the second kidney?* and

2. *Are there means of accomplishing this, and in cases where this is possible, in what do they consist?*

1. The first question might appear superfluous, as our reported cases have shown that the operations which were attempted were almost without exception the immediate cause of death. It is only lately that the statement has been made in various quarters, that the pathological condition of the second kidney forms no absolute contraindication to the operation, but on the contrary, there would be just so many more patients saved who die without an operation, if uninfluenced by the condition of the sister organ, one removed the recognizedly diseased kidney.

In regard to this apparent contradiction, we must go into this question more exactly.

There are two groups of cases which must be sharply differentiated, the first of which consists of *those in which a vital indication for operation exists*. These are for example cases where anuria has existed for several days due to plugging by a calculus, or where there is a pyonephrosis with frequently recurring chills. In both instances the patient will die if not operated upon, in the former very soon, and in the latter before long. It accordingly goes without saying that in such cases an operation must take place, whether anything is known of the condition of the second kidney or not. Only the operator would limit himself to a nephrotomy until he was certain that an

apparently sufficiently functioning kidney was present. Then he would add to it the extirpation of the organ, if an indication for it existed.

These cases we have outlined are opposed to another line of cases which represent the majority, in which A DISEASE OF ONE KIDNEY HAS BEEN ESTABLISHED, WITH WHICH HOWEVER THE PATIENTS UNDER CERTAIN CIRCUMSTANCES CAN STILL LIVE FOR YEARS. To this class belong numerous tumors, pyonephroses, hydronephroses, and cases of calculi and tuberculosis, in which troublesome symptoms certainly exist, symptoms however which are not so severe as to menace life or to rob the patient of its enjoyment.

HERE THE DECISION OF THE QUESTION WHETHER TO OPERATE OR NOT RESTS SIMPLY AND WHOLLY ON THE CONDITION OF THE OTHER KIDNEY. We notice cases of this sort as long as they remain undisturbed, keep for a long time in the same condition, even when the second kidney shows severe changes. But as soon as one attacks the supposedly more diseased kidney with the knife, these cases die rapidly, as the 27 reported instances have just taught us. It is especially noteworthy in this connection that a nephrotomy alone is enough to produce this fatal result. If this is a sure and well-grounded fact, it is evident that we shall more certainly accomplish what our object ever should be, that is, saving the life of the patient as long as possible, when we do not operate on these patients. This

proves that it is urgently necessary, in all cases of kidney diseases where no vital indication for an operation is present, for us to decide whether the second kidney will be unfavorably influenced by an operation on the diseased organ. This leads us to the second question.

2. Are there means of establishing this fact, and in what do they consist? Let us call attention once more here to a fact already stated elsewhere, *that it is not so much a question of whether the second kidney is sound, but much more whether it is capable of performing its function*; whether, when the first kidney either by nephrotomy or nephrectomy is partially or wholly removed, the second can then take upon itself the work indispensable to the preservation of the body.

We have no hesitation in avowing that it was a mistake if one supposed that every disease of the second kidney, which shows itself for example by the elimination of albumen, was a contraindication to operation. On the contrary we have become convinced that there are cases where the very discovery of albumen presents an indication for an operative intervention. In this category belong for instance those cases in which the second kidney, as the result of suppuration of the other, shows a not too far advanced amyloid degeneration. If we operate on such patients early, we may possibly save the second kidney which would otherwise be sure to degenerate. We do not believe that

parts of the kidney which have once become degenerated with amyloid will again become capable of work, but it is certainly possible that the portions which have remained normal will be protected from infection, if we remove the focus of suppuration.

The matter comes to this then: Can we decide this point clearly, *can we estimate the functioning power of a kidney?*

For all the methods of examination known up to this time, the answer to this question must be negative: Inspection, palpation, percussion, actinography, cystoscopy, the surgical exposure of the surface of the organ, all these together cannot tell us, whether a secreting organ is present, and much less, whether this organ is diseased or capable of function.

So as a last resort it was recommended *to cut open the kidney after exposing it*, in order to be able to carefully examine the cross-section. If the kidney on section looks sound and normal, the desired purpose has been accomplished. Many investigators formerly believed in this, and so do a few to-day who have not carefully followed the reports of kidney pathology of the last years.

But above all we must protest against the use of such a procedure as a diagnostic help except in the presence of very urgent conditions as a result of which there is no time or possibility of employing other means of information. THE SECTION OF A KIDNEY IS A SERIOUS

OPERATION. No man, not even the most careful operator, can warrant that the kidney will not be infected by the section or the subsequent sewing up. And even if one grants that there is little to be feared with scrupulously carried out asepsis, even then the degeneration of the kidney tissue which has been cut, and of that which borders on the cut surface cannot be avoided. The importance of this point was already well known, but clear light has lately been thrown upon it by Barth's¹ work, and by the reports of Braatz.²

Furthermore even by this section, we do not accomplish what we wish. IT IS EVIDENT TO AN EXPERIENCED PERSON THAT A DISEASE OF THE KIDNEY MAY BE PRESENT WHICH DOES NOT SHOW ITSELF JUST ON THE CROSS-SECTION MADE BY THE OPERATOR. A number of examples have been reported which prove this.

Albarran³ speaks of a case of kidney hemorrhage in which at the time of the operation *nothing was found macroscopically*, although later the histological examination showed the presence of *slight epithelial changes in the kidney tissue*.

Pouso⁴ reports the following case: A woman, 23, suffered for three months from severe hæmaturia with retention of blood clots in the bladder, and from great tenesmus. It was proved by the cystoscope that the hemorrhage came from

¹Chirurgen-Congress zu Berlin, 1900.

²Deutsche med. Wochenschrift, 1900, Nr. 10.

³Annales des maladies gén-urin., 1888, Nr. 5.

⁴Revue de Chirurgie, 10 Juli, 1898.

the right kidney, which was enlarged and displaced, but not tender on pressure. Since the other symptoms of lithiasis were absent, Pousson thought of a primary renal tuberculosis or of a renal pelvic epithelioma. Nephrotomy. The kidney was found enlarged and congested, but without excrescences or irregularities. Profuse hemorrhage accompanied the section. *Nothing remarkable about the cut surface*—in spite of this the organ was removed. Perfect convalescence. The urine since then free from blood. Histological examination showed a *high grade of connective tissue proliferation which had destroyed the vessels and glomeruli.*

Nimier¹ operated on a soldier who for five years had suffered from *renal hemorrhages* as a result of trauma. On account of their increasing intensity and pains in the left side, *left nephrotomy* was performed, and because it was supposed that an induration felt in the upper portion of the kidney was a neoplasm, a nephrectomy was added. The hemorrhages did not cease. The extirpated kidney was normal except for one place at the summit of a papilla, where there was a *diffuse proliferation of embryonal cells*, whose nature remained obscure.

Routier² removed a kidney on account of a hemorrhage menacing life, which *macroscopically seemed normal*, but on microscopic examination there appeared at the point of a papilla a *tuberculous lesion with a hole into a small artery.*

Braatz,³ in a case observed and operated on by him, calls attention to the fact that a negative finding at a diagnostic halving of the kidney does not always justify a diagnosis of nephralgia. The case was that of a girl of 30 who several times had had suppurating cervical glands. Later severe attacks of renal colic appeared in the right kidney region: the organ was round and swollen, and very sensitive to pressure.

¹ Casper-Lohnstein'sche Monatsberichte, 1898, Nr. 565.

² *Ibidem.*

³ Deutsche med. Wochenschrift, 1900, Nr. 10.

Urine showed white blood corpuscles, no tubercle bacilli. Since the kidney was movable, it was fixated. After beginning improvement there was an early return of the former attacks. The kidney was accordingly released; *section made, no diseased changes apparent*. Organ sewed up, and fixated as before. Diagnosis: Nephralgia. No colic for three years, then a gradual return, till finally the pains were unbearable, and nephrectomy performed. Kidney was small, irregularly contracted. At upper extremity was a small yellow spot somewhat elevated. On section it proved to be a cheesy tubercular abscess. Microscopically giant-cell tubercles recognized—at the lower extremity an old healed focus.

Braatz concluded that *at the splitting of the kidney the latter tuberculous focus was there, but was not hit by the section*. Through the hyperæmia and the reactive changes of the healing process following the section, the focus which was near it may have healed. With the formation of the new tuberculous abscess, the attacks of pain reappeared.

Since a high grade of contraction of the anterior side of the split kidney existed, Braatz believes that *the section is by no means an indifferent procedure, but much rather causes a severe injury to the organ. He therefore advises performing this operation as seldom as possible*.

Finally we cite the opinion of J. Israel¹ who says that a great part of these clinical pictures which begin with hemorrhages and colic, in spite of an *unchanged macroscopic condition* of the kidneys, *depend upon chronic inflammatory processes which can be recognized microscopically*.

We trust these short statements will suffice to prove that neither the palpation of the kidney surface nor even its section during the operation can give us information as to whether disease is present in this kidney

¹ Arch. für klin. Chir., 1900, LXI., Heft 3, p. 589.

or not. But since, as has already been mentioned, a diseased kidney may yet be able to perform its function, it is clear that the question we have to decide, whether the kidney still does sufficient work—cannot be settled by its section.

III.

THE METHODS OF FUNCTIONAL KIDNEY DIAGNOSIS.

The expedients thus far described give us, as we have seen, no definite information about the *kidney function*; they leave us much rather entirely in the lurch. We will now pass on to the explanation of the various sorts of procedures, and how they attempt, based in great part on the scientific advances of the last years, to meet the requirements described in our introduction, made by a rational method of kidney diagnosis. In doing this we will hold to the division of the subject made in the first chapter, and at first consider the question: *How do we attempt to establish whether the work of a kidney is sufficient or not?*

I. THE DETERMINATION OF KIDNEY SUFFICIENCY, AND INSUFFICIENCY IN GENERAL.

As long as men have busied themselves with this question they have always expected to decide it through the examination of *the kidney secretion—the urine*. The urine as the product of the activity of the kidney must be, so it was thought, an earliest indicator of how far this activity is sufficient. Certainly not

through the simple *qualitative* variations from the normal, through the admixture of abnormal morphological constituents or of albumen; for it is too well known to require mention here that these are by no means a measure of the severity and intensity even of an anatomical process—we have only to mention the contracted kidney—so much less information then do they give as to the loss of function. But at least in the direction of its *quantitative composition*: if it is the task of the kidney to free the body of the waste products of metabolism, the elimination of these broken down elements must also be incomplete—from a theoretical standpoint—when this task cannot be fully carried out. Thought has been especially directed to *proteid metabolism and disturbances in the elimination of nitrogenous compounds*, and we will accordingly next consider these.

(a) THE ELIMINATION OF NITROGEN BY KIDNEY PATIENTS.

On this very point there are so many conceptions spread abroad in the literature, in part erroneous, and in part leading to error, that a more detailed attention to it seems indicated, in that it is not only a question here of false hypotheses, but also of declarations to which a direct value is ascribed in regard to the question of practical operating.

One finds, even from authoritative sources, the idea

still often defended, that the estimation of the amount of nitrogen excreted during 24 hours, or a longer period, is of decisive importance in the question of the sufficiency of kidney function, that a considerable diminution speaks for a faulty power of work, and a drop to about a half of what is "normal" contraindicates a kidney operation, especially a nephrectomy.

When one searches through the reported cases in the literature—we will not attempt to speak of them in detail—in which the estimation of nitrogen was carried out from this standpoint, one finds often enough nothing more than the statement: the amount of urea was so many grams—"which corresponds to the normal amount"—or "is so and so much below normal," and so on.

The fact has been already many times emphasized, that such examinations are absolutely worthless, but yet cannot often enough have stress laid upon it, since time and again such statements are published.

Normal amounts of urea do not exist: a determination of the urea excreted, or more correctly, the total amount of nitrogen—for not only urea but a number of other nitrogenous end-products are excreted by the kidney—without controlling the amount of N in the diet, or consideration of the N excreted by the intestine, does not allow one to draw the slightest conclusion. Only an exact experiment in metabolism carried out with every caution and with careful attention

to its method would at least give comparable and discussable values, it being understood that the experiment extended over a number of days. From the very nature of the matter such a troublesome number of experiments could only be performed in the rarest cases; and on that account its value in practice can only be most limited.

But it is not only the technical difficulties which make these methods appear unsuitable, *for even the results obtained by exact means give no reliable information as to whether the function of the kidneys is sufficient or not.*

Let us suppose that the experiment in metabolism had shown a considerable falling short of the nitrogen excreted in comparison to the nitrogen ingested; then we would further have to discuss: 1. Can one from this result conclude there is a retention of nitrogen? and 2. Does this retention point to a faulty power of work of the kidneys?

In regard to the first point, we know from the general teachings of proteid metabolism, *that a deficit in the N balance by no means necessarily depends on a retention of nitrogenous products of metabolism in the system*, upon a stoppage of these in tissues and fluids, but that we have to do with an additional amount of albumen in the body. This point however has at all events more theoretical than practical importance; in a concrete case we will generally be able to form an

opinion as to which of the two contingencies is present. If the diet chosen is not especially rich in albumen, and if perhaps the patient is still losing weight, if it is a case of severe kidney disease, developing with cachexia and sapping the strength of the patient, an *accumulation* of albumen can well be excluded. But reversely it must not be forgotten that also *an approximate agreement between the nitrogen excreted and ingested by no means speaks against a retention of nitrogenous nourishment in the system*; as soon as forces are active which of themselves can lead to a breaking up of albuminous materials in the body, these can naturally accomplish so much that a simultaneous retention of nitrogen is fully compensated for, and does not express itself in the results of the experiment in metabolism. Such forces are active, only to mention the most important practical conditions, *in fever*: they further make their influence felt *in malignant new growths*, and it is at once clear that when one of the elements mentioned comes into the question—and exactly that is by no means so seldom the case with kidney patients who come to the surgeons' hands—the investigation of the N eliminations gives no results possessing an undivided meaning.

Still more important is the second question: *Is a retention of nitrogen, even when it is surely proven, in any way to be considered in the sense of a faulty functioning power of the kidneys?*

This would be possible only if first in the case of normal kidneys, a retention of nitrogenous products of metabolism had never been observed. Now we know that small quantities of N pro die can easily be retained, which occasionally, especially by more complete flushings with water, are all at once again eliminated. Even when it accumulates for a number of days, it is so small in amount that it practically does not come into the consideration, and yet an observation which Rosemann¹ has lately published is important and instructive, in which he shows that *occasionally in wholly normal persons, a very considerable retention of nitrogen can take place.*

The case was a normal individual on whom the experiment was performed, who had no symptoms of kidney disease, whose urine at least showed no trace of abnormal constituents. The experiment in the exact amount of metabolic change per day showed a retention of several grams of N for twelve days, until the kidney closure opened, and in the course of three days the whole amount of retained N was discharged. No plausible reasons can be asserted either for a faulty power of transmission, by the kidneys, of the end products of proteid metabolism, or for their suddenly acquired permeability. It was also interesting—and this point is of importance in reference to matters which will later be explained in detail—in this same

¹ Pflüger's Archiv, 1899.

person experimented on, there was also a retention of potassium of iodide. At any rate further substantiations of these introductory and as yet wholly isolated observations are needed before one can judge whether such *transitory functional kidney disturbances* occur in the majority of individuals otherwise normal, and so, not alone occasionally give rise to errors. At all events we think this point too important to be left out of consideration.

And what takes place in reference to N retention in kidney patients?

On this point exist a number of single observations, and especially the older reports give it as a regular and legitimate phenomenon, that with disease of the kidney parenchyma, the excretion of nitrogen is made difficult and diminished. That this can be so must be admitted on account of a few very extreme variations from the normal which reliable investigators report. But there cannot be the slightest possibility of seeing in this variation a typical relation, or of diagnosing a faulty power of work of the kidneys from it, or even of assuming a greater or less injury to their function from the amount of retained nitrogen, in view of the results of a large number of modern investigations. Among those considering the question in point we will mention the work of Fleischer,¹ Kornblum,² P. Mül-

¹ Archiv f. klin. Med., 1881.

² Virchow's Archiv, 1892.

ler,¹ J. Mann,² especially the experiments by V. Noorden and Ritter³ and the work of Köhler⁴ which has just lately been published.

The experiments seem to have contradictory results: for example Fleischer very often finds a considerable retention of urea, while Kornblum does not, and concludes that a diminution of N excretion is not present in kidney patients (nephritis). In the results of Köhler's experiments just recently made public, an even moderately considerable difference between N ingested and excreted was never found at all in four cases of parenchymatous and interstitial nephritis.

The contradiction explains itself in the investigations by von Noorden and Ritter. These authors were able to prove—and that is the most important point in the question now engaging us—that in chronic nephritic processes, periods of good and bad N elimination succeeded each other. These periods merged into one another at times abruptly and immediately, at times slowly and gradually. There was nothing in the condition of the kidney patients in other respects to indicate whether a period of N retention was to be expected or not. From these facts v. Noorden con-

¹Dissert. inaug. Berlin, 1891.

²Zeitschrift für klin. Med., 1892.

³Zeitschrift für klin. Med., XIX., u. Deutsche med. Wochenschrift, 1892.

⁴Archiv für klin. Med., 1899.

cludes "that there is no typical stable relation between the N ingestion and N excretion in chronic kidney patients, but that it is this very changeability in this relation that gives to the metabolism of these patients its characteristic stamp."

One sees from this how little can be decided from ever so exact an investigation extending over several days of the proteid economy of kidney patients as to the question of incidental retention of nitrogenous products and faulty elimination as a result of diminished kidney work, if the experiment is not repeated at various times spread over long intervals. For according as one accidentally comes upon a period of better or worse N elimination, one will find at one time an approximate N equilibrium, at another an N deficit. It is evident what fallacies are possible in this way.

From our explanation, one will find our conclusion justified, *that a calculation of the amount of retained nitrogen gives no information as to whether the kidneys are capable of performing their function or not. Investigations carried out in the most approved manner which estimate only the amount of nitrogen excreted by the kidneys, without controlling the nitrogen ingested, are useless and worthless; and even an exact experiment in metabolism gives no unequivocal results.*

(b) THE ELIMINATION OF CHLORIDES BY KIDNEY PATIENTS.

The relations in the elimination of salts by kidney patients are similar to those which exist in nitrogen elimination, especially with their principal representative, the chlorides. On this point also there are numerous older reports which declare that a faulty kidney power goes hand in hand with a diminution in the elimination of chlorides. More exact methods of investigation on the contrary have not been able to show that these statements are sound. The newest work also on this subject by Hofmann¹ proves convincingly that neither in cases of faulty kidney function in general, nor in its most characteristic manifestation, uræmia, do especial changes in chloride elimination present any constant picture.

We can therefore make these remarks suffice, since a retention of chlorides proves nothing in the way of insufficient kidney function.

(c) THE DETERMINATION OF THE MOLECULAR CONCENTRATION OF THE URINE (CRYOSCOPY).

In addition to the chemical analysis of the urine, especial interest has been directed to the study of its physical properties. The determination of its molecular concentration in particular has earned a place of

¹ Archiv für klin. Med., 61.

clinical importance for itself in the last years as a measure of the work of the kidneys.

The theoretical principles of the new diagnostic method, as far as they interest us here, are in outline as follows: The secretory activity of the kidney changes in the formative substance of the urine, in the blood and lymph, the relations existing between the dissolved elements and the water which dissolves them. Between the blood and urine, through the walls which separate them, the membrane of the capillaries, Bowman's membrane, and the epithelium of the tubules, a constant exchange takes place, which is regulated according to the physical laws of osmosis: the power of attraction of such solutions for one another is called osmotic pressure. This osmotic pressure is proportional to the molecular concentration of the solutions, and as Dreser has shown, is best measured by a determination of the lowering of their freezing point. The richer a substance is in molecules, the lower its freezing point lies under that of distilled water, and vice versa. To the kidneys, according to Dreser, falls the task of diminishing the osmotic pressure of the blood; therefore *under normal conditions, the lowering of the freezing point and with it the molecular concentration of the urine is greater than that of the blood. Vice versa in all diseases generally, and especially in diseases of the kidneys, their power of causing a change in the osmotic tension of the fluid which passes*

through them is diminished, and so the freezing point of the urine approaches that of the blood.

It is A. von Koranyi who has performed the great service of introducing into medical practice the determination of osmotic pressure, namely the molecular concentration of animal fluids through the lowering of the freezing point: The calculation of the osmotic power of the kidneys, as Dreser reports, is too complicated to have won for itself a place in clinical work. For the practical performance of the calculation of the freezing point, the apparatus designed by Beckmann (1888) is used.¹ It consists principally of the following parts. The inner tube *A* (in the accompanying illustration) contains a thermometer *E* divided into hundredths of degrees, and a mixer *D* made out of a

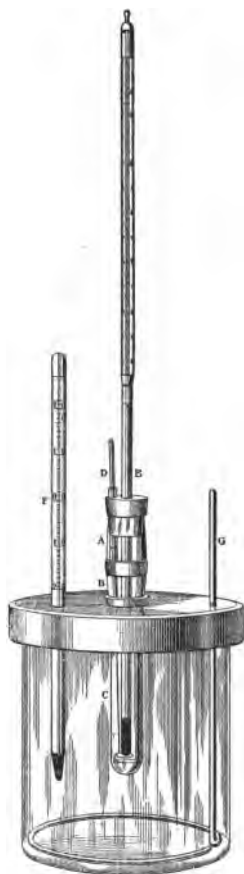


FIG. 1. Translators' Cryoscopic Apparatus.

¹Cfr. Ostwald: Grundriss der Allg. Chemie, Leipzig, 1899.

bent wire (platinum). It is charged with from 15-20 c.c. of the fluid to be examined, and then placed in the outer tube *B*, which fits into the wide vessel *C*, filled with a freezing mixture (salt and ice). A second thermometer *F* registers the temperature of the freezing mixture, and the bent wire *G* serves as a mixer. While constantly stirring, one watches the thermometer: the mercury at first sinks somewhat under the freezing point, then (in consequence of the warmth set free by the freezing) rises again, and at this point remains constant for several moments. First the freezing point of distilled water is determined, and afterwards that of the urine: the difference between the two is the lowering of the freezing point sought for = Δ .¹

¹The urine to be tested should not be heated, filtered, or treated with chemicals so as to in any way affect its molecular concentration. If it is first set on ice for a time to cool, the freezing process will be materially shortened.

The tube in which the urine is frozen must be scrupulously cleaned and dried, and should have a flat bottom to allow the mixer to reach all parts for even freezing.

The large thermometer should be divided into hundredths of degrees and enough test fluid should be used to at least cover the mercury reservoir at the bottom.

Freezing will occur most evenly if the temperature of the salt and ice registered by the second smaller thermometer is from 7-10° below zero centigrade. After obtaining the freezing point the ice particles in the test fluid should be carefully redissolved and the test repeated.

It is important, a point to which v. Koranyi has called attention, to have the urine to be investigated fresh. Its ammoniacal fermentation, as a result of the changing of the urea into ammonium carbonate, and the loss of solid particles dependent on it, very markedly vitiates the results: it is therefore best never to use decomposed urine at all for such calculations.

A. von Koranyi¹ has been able to establish by means of this method in kidney diseases the following facts. The urine of kidney patients may show changes in its molecular concentration, but it does not do so necessarily. Changes are not present where a portion of the kidney parenchyma is diseased, if the power of work of the diseased areas is fully compensated for by sound tissue. An injury to the kidney function will on the contrary show itself by an abnormally slight lowering of the freezing point² of the urine, implying

It is customary to take the second reading, which is generally about .02° higher than the first, as the final result, and not the average of the two. [Translators' note.]

¹Cfr. *Zeitschrift für klin. Medicin*, 1897, und *Berliner klin. Wochenschrift*, 1899. Casper-Lohnstein's *Monatsberichte*, 1899, etc.

²In speaking of a "low" freezing point, the authors refer to the distance of the mercury column below 0° C., and not to the numerical value of the reading. Thus -0.96° is a lower freezing point than -0.87° (further below zero) though the figures are numerically higher. Furthermore a "low" freezing point is produced by a "high" molecular concentration and vice-versa. (Translators' note.)

a small percentage of solid molecules, a so-called *hyposthenuria*. This can manifest itself to such a degree that the difference between the freezing points of the blood and the urine will disappear entirely, or even the usual relations may be reversed, and the freezing point of the urine be nearer zero than that of the blood. (For the sake of briefness we will designate the freezing point of the blood by δ , and that of the urine by Δ , following the example of A. v. Koranyi.) The calculation of the specific gravity of the urine cannot serve as a substitute for the determination of the freezing point. The amount of albumen in the urine of kidney patients is often an indicator for the specific gravity, while it has practically no influence on the lowering of the freezing point.

The value of the method is, according to v. Koranyi, chiefly *prognostic*: in the presence of reparative processes, of an improvement in kidney function, the freezing point becomes lower, its approach to zero, on the contrary, has an unfavorable significance.

In the sense that the sort of kidney disease, especially that the various forms of nephritis are characterized by the amount of the lowering of the freezing point, the procedure according to v. Koranyi is not *diagnostic*, or at least only in a special direction to be mentioned later.

The results of a large number of investigations by various authors have already been published which

have substantiated the statements of Koranyi practically throughout, and have proved that the objections raised against them are not supported by facts.

A point which has been universally corroborated (Lindemann,¹ M. Senator,² Albarran,³ Moritz,⁴ Claude et Balthazard,⁵ Pöhl⁶) is that the urine in kidney diseases, especially in nephritis, shows an abnormally small molecular concentration. V. Koranyi reports as the normal freezing point of the urine figures somewhere between 1.3° and 2.3° C. under that of distilled water. According to Lindemann the variations range between -0.9° and -2.70° C. The readings in kidney patients on the contrary are almost always less than -1.0° C.

Especially convincing in this respect are the investigations of Moritz, who examined the kidneys microscopically in twelve fatal cases, in which during life the freezing point of the urine was estimated over long periods of time. The results of the microscopic finding were always in harmony with the calculation of the molecular concentration; where the latter was strikingly low, there were always severe changes in

¹ Archiv für klin. Med., 1899, Bd. 65.

² Deutsche med. Wochenschrift, 1900, Nr. 3.

³ Annales des maladies génito-urinaires, 1899.

⁴ Petersburger med. Wochenschrift, 1900, Nr. 22.

⁵ Presse médic., 1900, Nr. 14.

⁶ Zeitschrift für physical. und diätet. Therapie, 1900.

the kidney parenchyma, while they were slight or altogether absent with a relatively low freezing point.

The sort of kidney disease seems to cause no characteristic differences in the lowering of the freezing point, at least not in actual figures. However Lindemann claimed in opposition to the statements of v. Koranyi, that in cases of genuine contracted kidney, the variation from normal in the freezing point was only inconsiderable, while the chronic-parenchymatous form was characterized by a very pronounced diminished lowering. Such a universal distinction is not probable, or if present, certainly confined to a few cases, for the reason that while typical cases of one or the other sort do exist, it is generally a question of mixed and transitional forms. The investigations on this point reported by Moritz moreover have not confirmed Lindemann's view.

Lately Roth-Schulz and Kövesi¹ are laying emphasis on the fact that it is not so much from the figures as from the *changeability* of the freezing point on the ingestion of water, that diagnostic points are to be drawn for both forms of nephritis. In parenchymatous nephritis the power of the kidneys to furnish a diluted urine is diminished, while it is only slightly affected in contracted kidney. Both accordingly show a different power of accommodating themselves to the fluid economy of the system.

¹ Berliner klin. Wochenschrift, 1900.

The freezing point method will prove itself of diagnostic value finally, a point to which Lindemann first called attention, when it is a question of establishing an encroachment of the pathological process from the lower urinary passages onto the kidneys. Cystitis and pyelitis in themselves cause no change in the freezing point; but if with a moderate amount of urine a variation in the molecular concentration appears during the course of the disease, it must be taken as evidence that the kidney parenchyma has also become involved. We ourselves have observed similar cases several times, but wider experience must first decide whether this deduction, drawn thus far from but a small number of observations, possesses such general applicability that practical diagnostic methods can make use of it.

At all events the method of calculating the freezing point of the urine, cryoscopy, seems to be a valuable addition to our diagnostic armamentarium, and we must agree with Koranyi when he says that his procedure allows us to more exactly determine the course of kidney diseases, than was formerly possible.

It has further an undeniable advantage over the chemical quantitative analysis of the products of metabolism eliminated by the kidney, especially over the determination of the amount of nitrogen, chlorides, and the like, in so far as *it demonstrates not the faulty excretion of a single element, but the total of the solid molecules eliminated by the kidneys.* We have already

stated that the calculation of the specific gravity offers no approximate substitute. *Finally the procedure is technically easy and can be done quickly*, and in contradistinction to the complicated determination of the nitrogen, can be carried out without trouble to physician or patient on small amounts of the day's urine over long periods of time.

We must however make certain reservations in the conclusions we draw from this method: a freezing point of the urine less than -1° C. cannot always be attributed to insufficient work of the kidneys. For a large amount of ingested water, even in normal individuals, reduces the molecular concentration of the urine considerably. M. Senator found after drinking-bouts, figures from -0.6° to -0.8° C.; Koranyi and Kövesi-Roth also report that in such cases the lowering of the freezing point diminishes up to -0.1° and less, a proof of how quickly normal kidneys adapt themselves to the amount of water taken. A case of diabetes insipidus (of M. Senator) showed about as low figures—from -0.3° to -0.4° . And so when we see how greatly, according to the investigations of Roth-Schulz and Kövesi, and how differently with kidney patients, the freezing point of the urine is influenced by the amount of water taken, aside from the retained renal permeability for solid molecules, we will use the method for diagnostic purposes only in those cases where there is no considerable polyuria, and where no too great amount of water has been taken.

And furthermore, according to Koranyi's statements, *a low molecular concentration of the urine will be found in the various forms of anæmia*; the freezing point here shows figures which vary around -0.80° . Thus in cases of severe anæmia, deductions as to a contingent faulty work of the kidneys, from the lowering of the freezing point of the urine, must be drawn with care.

But is now the grade of molecular concentration of the urine to be regarded in general as a measure of the kidneys' work, so that from it—for that was the point of interest to us—we can say whether the excretory function of the kidney is sufficient for the needs of the system or not?

In spite of the undeniable advantages of the method which we have more than once mentioned, it is no more true than that we can draw any such conclusion from a diminished amount of urea or chloride excretion. An insufficient amount of kidney activity asserts itself by a retention in the body of a number of elements which are destined for elimination. The grade of disturbance connected with insufficient kidney power is in proportion to the quality and quantity of these elements. *And so in this respect it is not a question of what the kidneys eliminate, but what they fail to eliminate. It is not the amount of solid molecules eliminated in the urine, it is not their actual number, and not the absolute measure of kidney activity deter-*

mined from this, that at all decides the question in regard to the kidney's power of work. But what is most important lies in the *relative ability* and manner in which the kidneys are capable of excreting the broken down products of metabolism. In other words, *it is the relation between the eliminated and retained substances*. And since the latter are the causes of the systemic disturbances set up by the kidney insufficiency, the most rational thing to do seems to find a method which will tell us *the amount of retained products of metabolism*, and give us at the same time an indication of the grade and extent of the kidney disturbance. We shall see later on that of all the methods in use, one alone, the determination of *the molecular concentration of the blood* introduced into clinical practice by Koranyi, meets these demands, and later come back to this point in detail.

(d) THE ELIMINATION OF SUBSTANCES ARTIFICIALLY
INTRODUCED INTO THE SYSTEM AS A MEASURE
OF KIDNEY FUNCTION.

We have thus far explained in what degree the elimination by the kidneys of those elements which are found in the *natural* course of metabolism suffers in the presence of a disturbance of renal function. It has now been further attempted to gain an idea of the variations from normal of the kidney activity, by introducing foreign substances artificially for purposes

of experiment, and by studying more closely the relations which govern their elimination.

The principle of this procedure is by no means new, for experience has long since taught that certain elements pass over into the urine with more difficulty in kidney patients than in normal individuals.

Originally at any rate, this was limited to substances possessing an odor. The physicians of former times (for instance Hahn, 1820; Reyer, 1837) taught that the characteristic odor of violets after ingestion of turpentine, or the well-known odor which comes after eating asparagus is absent in the urine of patients with nephritis; Beauvais even tried in 1858 to make a characteristic *diagnostic* point from this finding.

Also the unpleasant experiences from the delayed elimination of certain *medicines* which were met with in kidney patients with various remedies in the pharmacopeia: their intolerance for opium, mercury, quinine, salicylic acid, etc., gave rise to investigations which repeatedly established a retarded excretion of such substances.

This is not the place to cite single observations of this sort which have been made from time to time. Viewing them collectively from a common standpoint, as well as methodically introducing such methods of proof for the purpose of establishing the kidneys' function, has been the work of only the last years.

Among the many substances used for this purpose, one, *methylene blue*, has gained a certain importance, especially owing to the most minute and detailed study of its elimination in the system of normal individuals and kidney patients. For this we have to thank Achard, who was the one to introduce the expedient into kidney diagnosis. Achard and his pupils in numerous publications have given us detailed information of the phenomena of the elimination of methylene blue, and there exists already a relatively comprehensive literature on this subject. If anyone wishes to inform himself on this point, he will find the data collected in Achard's and Castaigne's little monograph: "L'examen clinique des fonctions rénales."¹

We must content ourselves in what follows with a short critical resumé of the results.

And next a few words as to the method of administration: Achard uses an intramuscular injection of 0.05 gram methylene blue: a test carried out methodically comprises the *time of beginning* of the elimination, *its duration*, and *the amount* of the excreted coloring matter. The elimination of methylene blue, which undergoes a reduction in the tissues, is completed in two modifications: as a chromogen, which after oxidation, or most simply by heating and adding acetic acid, become methylene blue again; and as the

¹ Paris, 1900.

original coloring matter which appears in urine as a greenish hue.

In normal cases, the chromogen as well as the real coloring matter appears in about one fourth to one half hour after the injection; a delay of from one third hours is taken to point to an impermeability of the kidneys. But as Achard himself admits, small remaining portions of functioning kidney parenchyma are enough in themselves to permit an amount of coloring matter, though small, to pass into the urine at the proper time; *and so we can make no use in diagnosis of the simple fact of a delayed elimination.*

We are just as little able to draw binding conclusions from the *duration of the excretion*: *With kidney patients it may be shortened, but it also may be prolonged.* The duration is shortened, that is to say, the methylene blue is more quickly eliminated than normally, often in acute as well as subacute cases of nephritis, and not seldom also in the chronic-parenchymatous type, while a protraction is very often observed in interstitial kidney inflammatory changes. But this protraction, a point to which Albarran and Bernard¹ have rightly, in our opinion, called attention, is by no means necessarily a sign of disturbed power of transmission; it can much rather, as is proved by their cases in which they tried to use methylene blue in the diagnosis of unilateral kidney disease—a mat-

¹ Annales des maladies des org. gén.-urin., 1899.

ter to which we will return later in detail—be the consequence of a compensatory hypertrophy of the normal remaining portions of the kidney parenchyma. In this event it would prove exactly the opposite of what it should show: not a diminished but an increased kidney function.

Achard ascribes the greatest importance to the determination of the amount of eliminated methylene blue. But he himself confesses that the procedure is detailed; the urine must be most carefully collected during the whole of the period of methylene blue elimination, often extending over many days. Besides, the method of determination employed is colorimetric, and so not very exact. It consists simply in the comparison of a specimen of the well mixed 24-hour amount of urine with a solution of methylene blue, of known amount, and by dilution brought to the same color. In this way, the average amount eliminated by normal individuals is reported as about 25 mgr. in the first 24 hours.

The consideration of all these factors mentioned shows that a diminished transmission of methylene blue occurs principally in cases of interstitial nephritis: the amount eliminated is diminished, the duration is prolonged, and the time of the start is delayed; on the contrary the methylene blue elimination shows little or no abnormal modification in cases of the acute and more parenchymatous type, as well as in amyloid nephritis.

This already proves that in the methylene blue test, possibly under certain circumstances we are dealing with a valuable corroborative diagnostic expedient regarding the seat of pathological lesions in the kidney; a procedure which in topical kidney diagnosis probably promises to give much information.

But in view of what has been said, it in no way furnishes a general means of measuring disturbed kidney function. For certainly the parenchymatous form, in which the permeability for methylene blue is preserved, produces symptoms of kidney insufficiency just as often as the interstitial type, in which the power of transmission is weakened. And also in the latter type, which undoubtedly offers the real province for the employment of the method, the impermeability for methylene blue runs by no means parallel to other severe disturbances of kidney function. As Widal and Vaquez have most emphatically stated, there are contracted kidneys of high grade with the most severe uræmic symptoms, in which even during the uræmic attack, the power of eliminating the dye is fully preserved.

Even if one considers such cases as only rare exceptions, there yet remain certain general considerations which most prevent us from drawing from this test any far-reaching conclusions in regard to the question before us—the kidney function.

In the first place we cannot wholly pass over the

objections to the choice of methylene blue as a test-substance, for it does not pass through the kidneys unchanged, since it is partially reduced in the system; it thus is possible that not only the work of the kidneys but also the activity of the tissues in which the reduction process takes place, has something to do with the amount of the coloring matter eliminated.

Still more important is a second point, which especially Lépine, Albarran, and Bernard have brought into prominence. *Even if one acknowledges that the permeability, especially of the kidneys, for methylene blue shows unvarying changes under certain circumstances, still that does not prove that the excretory power of the kidneys has suffered for general purposes at all.* The kidney, as we know to-day, possesses for different substances a varying power of selection: disturbances in the elimination of one are not necessarily associated with such for others. There is a certain interest in the study of how far these disturbances apply to *single* substances whose retention is connected, or appears to be, with severe toxic symptoms on the part of the body. From this standpoint, men have attempted to ascribe to the retention of products of proteid metabolism and salts, the significance of a symptom of injured kidney function, while they have also erroneously considered that the cause of the most characteristic expression of kidney insufficiency, *uræmia*, lay in these retained substances.

However deeply the general eliminating power of the kidneys for an indifferent substance introduced into the body may be studied, it must first be shown that this substance is also analogous to a number of others, whether they may be introduced from without, or whether they originate from the products of metabolism itself. But methylene blue however does not meet both requirements.

In the question of introducing other substances foreign to the system, coloring-matters, for example rosanilin trisulfonatrium (Lépine), or potassium iodide and others, the relations governing their elimination give results which do not harmonize with those obtained with methylene blue.

It seems more important to investigate whether a parallel exists between the elimination of methylene blue and the products furnished by metabolism itself, whose excretion falls to the task of the kidneys. Achard and Castaigne as well as Chauffard and Castaigne claim this is the case; but Albarran and Bernard in the light of their investigations express themselves in a somewhat different sense. They very often observed in cases of severe destruction of kidney substance, where also the secretory power in general had appreciably suffered, that disturbances in the elimination of coloring matter were coincident with similar ones in further urinary elements; but they noticed on the other hand, a clear disparity between the two in cases where the anatomical lesion was not so severe.

This short sketch will suffice to prove that this method cannot be looked upon as *a general functional test* of the excretory activity of the kidneys, in spite of the great care employed by Achard in its development, and of the everywhere recognized valuable results which he has won with it. A disturbance in the elimination of methylene blue does not prove *a disturbance in kidney function in general*. What is true of methylene blue is true of the other substances (some of which have been mentioned), which have been employed as substitutes. We can accordingly omit an enumeration of them.

(e) THE CHEMICAL ACTIVITY OF THE KIDNEYS (FORMATION OF HIPPURIC ACID AND RENAL GLYCO-SURIA) AS A MEASURE OF KIDNEY FUNCTION.

We have thus far considered the kidneys only *from a point of their excretory power*. We have inquired into how far a sufficient or insufficient elimination of various substances indicates an adequate or inadequate power of work.

But besides its excretory, the kidney has *chemical* tasks to fulfill: it not only excretes substances brought to it by the blood, but it also possesses the power of actively forming substances synthetically. It readily occurs to one *to make use of the products of these chemical processes as a measure of the amount of kidney work*.

Here, at all events, we are moving over rather unknown territory, for we have exact information, properly speaking, concerning only *a single direct chemical product of the kidney parenchyma*, namely its function of *synthetically forming hippuric acid* out of benzoic acid and glycocoll. That a diseased kidney can perform this task only in smaller degree, or that it cannot fulfill it at all seems, a priori at least, not improbable, and we find as a matter of fact, that this line of thought has been followed out for a long time.

As early as 1879, Jarsfield and Stockvis¹ reported investigations, in which they studied the elimination of hippuric acid in kidney patients: they reached the conclusion, that the power of excreting as hippuric acid administered benzoic acid, was impaired or lost in kidney affections. But there were however considerable differences depending on the pathological character of the kidney disease: the hippuric acid elimination suffered most in parenchymatous nephritis, less in amyloid, and practically not at all in contracted kidney. These results are rather startling—for the kidney parenchyma in its true sense suffers certainly in interstitial nephritis no less than in the so-called parenchymatous form. But to attempt at best to explain the statement by supposing that a compensatory hypertrophy of the tissue had taken place in the normal remaining portions of the kidney where the power of

¹ Archiv f. exp. Pathol., Bd. X.

hippuric acid formation was preserved, is unnecessary, as the authors themselves in a later report¹ have called attention to sources of error in the experiments, so that they require no argument.

Only lately Achard² has again undertaken such experiments, in which he subcutaneously injected equal amounts of benzoic acid into kidney patients and normal individuals. He wished in this way to prove whether the transformation of benzoic acid was restricted in kidney patients, whether it appeared unchanged in their urine, and whether the amount of hippuric acid produced was smaller than in healthy persons. The first was not the case: and also in patients with the most severe kidney disease, benzoic acid never appeared in the urine. On the contrary patients with nephritis reacted to the benzoic acid injection with a considerably smaller quantity of hippuric acid elimination than healthy persons.

Achard himself does not wish to draw any conclusions from the still small number of observations, and it must be admitted that however interesting theoretically such experiments may be, and however desirable their continuation, they promise no trustworthy results for medical practice for the reason that the methods of determining the amount of hippuric acid are

¹ Archiv für exp. Pathol., Bd. XVII.

² Achard et Castaigne: L'examen clinique des fonctions rénales, Paris, 1900.

not yet sufficiently exact to give absolutely certain numerical values. We cannot furthermore pass over other strong objections: we have only to mention that at present sufficient data do not exist to answer the question whether and to what degree other organs in addition to the kidneys participate in the formation of hippuric acid.

But we know of still *a second chemical process* which goes on in the kidneys, in which they do not indeed form independently a substance which is not also present in the blood, in which however an active chemical power of work of the kidney parenchyma plays a part: *that is the sugar elimination following the administration of phloridzin*—an example of a so-called renal glycosuria.

We shall show in detail in the next chapter that the method introduced into chemical practice by Achard and Delamare of determining renal function by the use of *phloridzin*, cannot measure the sufficiency of kidney work in general, but that on the contrary in its form of employment as given by us, *it proves especially adapted to calculating the amount of work of each single kidney*.

(f) THE TOXICITY OF THE URINE AS A MEASURE OF
KIDNEY FUNCTION.

The method inaugurated by Bouchard of determining the *toxicity* of the urine by biological means, that

is by its effect on living systems, as well as estimating the eliminating power of the kidneys by the degree of poisonous effect produced by this urine, takes for granted that among the substances the kidney excretes, one class possesses a very especial importance. To this belong such substances as cause by their accumulation in the body severe injuries which we to-day group together under the term "autointoxication." *Since this theory maintains that the principal task of the kidneys consists in the removal of poisons from the system, it estimates their functional power exclusively according to the degree in which this removal takes place.*

The physiological principles of the method rest on the fact that normal urine displays intense toxic effects. We can as little explain this fact, as we are convinced of its correctness. As to the nature of these poisons we possess practically no knowledge. We only know that a guinea-pig reacts with toxic symptoms to an intravenous infusion of a certain amount of urine, and in the course of a more or less varying period, dies. We further know that with normal urine, the fatal dose is between 40 and 50 grm. per kilo of the guinea-pig's weight, and that the effects of this dose can show considerable variations, which, according to Bouchard, depend upon the increased elimination or the retention of poisonous substances in the body.

We must next ask whether this test-method of the

toxicity of the urine is sure, whether the disease and death of the animal experimented on depend wholly upon the administration of poisons which are present in the human system, and which are eliminated through the kidneys.

We have at present been taught by a large number of more careful experimental studies in this direction that this is not the case. On the contrary the reaction shown by the animals used for experimental purposes is, in addition to the toxicity of the urine, to be attributed to a number of contingent circumstances.

In the first place the *method of performing the experiment* cannot be called in itself harmless to the animal. The amount of injected fluid, the speed with which it gets into the circulation, cause important dangers. Besides, in these intravenous injections, thrombus formation has been repeatedly observed, which leads to an early death of the animal, wholly independent of the amount of toxin. Further, the speed with which the injection is performed is of great importance, a fact to which Halion and Carion have called attention. Among the large amounts of poisons which the urine contains are those which take effect slowly as well as those which work quickly. The more rapidly the injection is carried out, the more naturally will the effect of the latter predominate.

The most important point, which is unquestionably of decisive significance in passing judgment on this

procedure, has been put in the right light only by the investigations of the last years (Hymanns van der Berg, Claude et Balthazard, Posner und Vertum). *A portion of the poisonous effect is to be ascribed not to chemical but to physical influences, to the difference in the osmotic pressure of the injected urine and the blood of the animal experimented on.* To calculate the purely chemical factor in the toxic effect, this element must be excluded, that is to say, the urine must be diluted until its molecular concentration corresponds to that of the normal blood, until it has with it an equal tone. However it is very difficult to produce an isotony between blood and urine, and the trouble which various authors have taken in this direction (Bernard, Halion and Carion) to calculate separately the factor of the osmotic toxic effect, and to correct the so-called urotoxic coefficient, according to the amount of dilution necessary, has hardly been rewarded in view of the variations in their results.

All these sources of error, connected simply with the performance of the experiment, cause it to appear unnecessary to still go into a detailed description of its significance in the understanding of renal function. When one of its principal supporters, Bernard, says that it can render valuable service in this direction, if one regards it in a "biological" and not a "mathematical" light, and when he expressly adds, that the figures in the toxicity of the urine cannot be regarded

as absolute, he has already passed the severest criticism on its diagnostic value. For on the contrary we are seeking a method which will give us in figures expressible and comparable values for the degree of disturbance of renal function, wholly leaving out of the question the fact that it seems erroneous, even in a biological light, to measure disturbances of the human system by those of a guinea-pig.

(g) THE PROOF OF RENAL INSUFFICIENCY BY THE INVESTIGATION OF THE BLOOD. (DETERMINATION OF ITS MOLECULAR CONCENTRATION.)

We have already explained that this method, namely the comparison of the products of metabolism retained in the blood, with those eliminated by the urine, is the only one which can tell us anything about the sufficiency or insufficiency of the kidney work.

Efforts to look upon the increase of one or another of the elements of metabolism in the *blood* as pathognomonic of an insufficient renal function have been repeatedly made; in cases where they have succeeded, that is to say where it was possible to recognize a retention of urea, chlorine, kreatinin, etc., in the blood of kidney patients, they can still never be regarded in the sense of a general functional disturbance of the kidneys. They only show that the substance in question is temporarily furnished by metabolism in greater amount than is eliminated by the kidneys. Such

methods cannot earn for themselves a clinical recognition because the necessary chemical analysis of the blood serum is too difficult and too subtle to be generally feasible in medical practice.

In distinction to it, the method introduced into clinical practice by A. v. Koranyi of determining the molecular concentration of the blood, implies a real advance. In the first place, it does not calculate the retention of a single product of metabolism, but it measures the total of retained molecules. It is secondly easily carried out technically, and finally by its aid it is possible to recognize even small variations from the normal, since the molecular concentration of the blood under normal conditions presents a stable, hardly changing value.

As has been established from numerous investigations during the last years (Dreser, Winter, Burgarsky, Koranyi, and others), the molecular concentration of normal blood, in a number of animals (guinea-pig, dog) as well as in men, lies between 0.56° and 0.58° C. below that of distilled water. This constant value is maintained under ordinary circumstances, as reported in the conclusions reached by Koranyi, by two factors which are antagonistic, and accordingly mutually neutralizing. One is the activity of the body metabolism. In metabolism a constant breaking down of the large proteid molecules into a great number of smaller molecules is going on, a proc-

ess which in itself has no influence on the molecular concentration. These small molecules collect in the blood and tissues, and have the power of appreciably raising the osmotic pressure of the tissue fluids. The second opposing factor is the work of the kidneys: to them, as we have before stated, falls the task of freeing the tissue fluids of the surplus of small molecules, and of reducing the osmotic pressure of the blood. A greater or less degree of disturbance of kidney activity will disclose itself first in an increase of the molecular concentration of the blood, in so far as no factors compensating for the insufficient kidney work intervene. Among these compensating factors v. Koranyi includes: first, a retention of water in the system which prevents an elevation in the molecular concentration in spite of the absolute increase of the solid molecules; and secondly, an adaptation of the proteid metabolism to the conditions furnished by the inadequate renal activity. If the system requires less albumen, or if the cells use up a smaller amount of albumen, or do not convert it into the same end-products as formerly, that is, not into such small molecules, the absolutely diminished permeability of the kidneys can be relatively sufficient to prevent an accumulation of solid molecules in the blood.

We shall soon see that these limitations of the method are not only theoretical, but in addition to other factors still to be mentioned they can also be of great

practical importance, and for a correct interpretation of the results it gives, must be well taken into consideration.

In the verification of the theory we have developed we can next make use of experiments on animals. These confirm it fully. They show first that a normal kidney after the removal of the other is perfectly capable of maintaining the molecular concentration of the blood at the normal figures of -0.56° , -0.57° C. This conforms to the experience often met with in renal surgery, that the sufficiency of kidney work is dependent upon the normal condition of only one organ. At the same time however from this the important fact becomes evident that *an elevation of the molecular concentration in general*—of the restrictions we shall later speak in detail—*points to a disease of both kidneys.*

Experiments on animals further show that the molecular concentration of the blood will be increased in proportion to the artificially produced injury to both kidneys, so that in fact we possess in it a simple and excellent means of measuring the intensity of the disturbance.

In *human* kidney pathology, matters are not quite as simple, and we can promote the development of this new method, as Koranyi has stated, by giving proper attention to the limits of the results it gives, as well as to the possibility of leading us into diagnostic errors.

Such errors can be occasioned first by incorrect methods of procedure, so let us in a few words consider these. We need in the determination of the freezing-point of the blood, which is performed in the same manner as described for the urine, about 15–20 c.c. This can best be obtained, not by a cupping-glass—for according to Lindemann such blood gives rise to sources of error from the admixture of lymph—but by venesection or venepuncture of one of the veins of the arm. It will be useful to always pass oxygen through the venous blood before its examination, since an increase in the blood's molecular concentration may also occur from respiratory insufficiency. This will be neutralized by the oxygen stream, while that due to renal insufficiency on the contrary will not be affected.

Furthermore in investigations on human beings, *the diet requires careful attention*. For as Koranyi has proved, the lowering of the freezing-point of the blood in the presence of renal insufficiency is to a large degree dependent upon the diet chosen. Experiments suitable for comparison showed that the freezing-point gives its highest values in cases where there is a deficiency in carbohydrates possibly due to a formation of aceton, while the figures were found lowest where carbohydrates were richly supplied to the system. It will be accordingly well during the investigations to see that the diet is rich in carbohydrates, to as far as possible exclude the element of error, and not to de-

prive oneself of one of the principal advantages of the procedure, namely, obtaining results which are expressible and comparable in figures.

But even when these precautions are carefully followed, *does an increased molecular blood concentration always point to an inadequate renal function, and does a normal concentration always imply a normal kidney power?*

This is not so, as A. v. Koranyi has already proved. In regard to the first question, *a higher value for δ that is, over -0.58° C., can also be found, when with no pathological process of the kidneys, their circulation alone is continuously or temporarily obstructed.* Thus high values for δ are found with large abdominal tumors, especially however with large kidney tumors, in spite of the fact that the other kidney is normal. Koranyi observed in a case of a large pyonephrosis, a value of -0.68° for δ , which receded to -0.57° after the extirpation. Koranyi was further able to prove that unilateral renal pain also temporarily affects the function of the other kidney, and causes a quick perceptible rise in the molecular blood concentration. Thus during a unilateral renal colic, δ equalled -0.76° , while after the attack, and in the intervals free from pain, the finding was only -0.57° . In the presence of unilateral kidney disease, an apparent renal insufficiency can be produced, at least temporarily, by mechanical as well as reflex causes, without any

pathological lesion of the other organ, and as the course of events after operation shows us, without any lasting disturbance in its function. It is evident that in reference to the case first mentioned, the practical application of the method is considerably limited. For it is in just these operations on kidney tumors that it is very important to determine whether a renal insufficiency exists from the very start as a result of disease of the other kidney, that is to say, whether the prospects of good results from an operation are improbable, and whether it is absolutely contraindicated from an increased finding of δ . If now the simple presence of a large kidney tumor is enough in itself to increase the molecular concentration of the blood through congestion and changed circulatory conditions even without disease of the second kidney, the information we seek cannot be obtained in this way.

The second exception mentioned above seems of less practical importance, for in cases of nephrolithiasis, in which surgical treatment is to be considered, an examination of the blood in the intervals between attacks would be enough to exclude sources of error.

What is true now of the condition of normal blood concentration? When it is present is one justified in at once excluding a renal insufficiency? As we have seen above, there are two factors which in kidney patients oppose an increase in the molecular concentration. The presence of one or the other of the two

makes it impossible to determine definitely, even when δ is reported -0.56° , that the kidneys perform adequate work. One is the dropsy of kidney patients. Koranyi himself reports cases, and Senator has also observed similar ones, where a wholly normal δ -value was found in the presence of severe parenchymatous nephritis with accompanying ascites.

In kidney surgery, such cases would certainly not come under consideration. But the second circumstance mentioned above plays in it a considerable rôle, namely, that an adaptation of the system to the proteid metabolism, a limitation in its amount can occur, which directly opposes, especially in poorly-nourished run-down individuals, an increase in the molecular concentration of the blood. Koranyi also calls attention to the fact that the lowering of the freezing point of the blood is abnormally small in severe anæmia, and that when anæmia exists as a complication, a full sufficiency of kidney power cannot be deduced. Both factors working against one another, renal insufficiency on one side, and anæmia on the other, can so neutralize each other that, just as we have seen in the case of the urine, a fully normal δ -value results. When we consider now how often, in kidney cases which are destined for the knife of the operator, we are dealing with individuals who are very poorly nourished, severely anæmic and cachectic, we see that in a further line of cases the determination of the molecular blood concentration proves but little.

Although thus the practical sphere of application of the method is appreciably narrowed—and a much greater amount of experience in kidney surgery than we now have is needed before we can define its limits—there still remain a large number of cases in addition in which this procedure can be of advantage. The proof of this lies in the observations made by Koranyi, by Kümmel, who as the first surgeon to employ the method largely, won especial credit for its development, and the experiences which we ourselves have had with it: all of them in cases in which not only the renal sufficiency determined by this method found in the operation and the later course of events a brilliant confirmation, but also cases which were not operated on because of an insufficiency determined in this way, and where the autopsy in fact disclosed severe irreparable changes in both kidneys.

The diagnostic value of the method does not consist in following a pure formula—in considering that a value of $\delta = -0.56^\circ$ or -0.57° proves an adequate power of work by the kidneys, and thus indicates a kidney operation, or that a value of -0.59° or over is the expression of a deficient kidney activity, and thus contraindicates surgical intervention. Leaving out of the question those other considerations previously enumerated, which are taken into account in establishing an eventual post-operative kidney insufficiency, considerations which not only have in view the work

of the kidneys in its totality, but also that of each kidney, and the manner in which it does its work, the method will prove of value only in the hands of one who strives to learn more of the physical principles on which it rests, and in this way is able to interpret from it what it can offer, no more and no less. Otherwise it can do more harm than good.

2. THE DETERMINATION OF THE FUNCTIONAL POWER OF EACH KIDNEY.

We now come to the consideration of the second question which is most important in reference to the issue of a kidney operation: How great is the working power of each kidney, what proportion does the amount performed by each bear to the total?

In the decision of this point we doubtless have an easier task before us than when it was a question of determining the sufficiency or insufficiency of the kidney work for the whole system. We saw that it was impossible to come to a decision on this latter point by the investigation of the urine, though directed along various lines, because it was less a question of calculating the amount of *eliminated* than of *retained* substances. But no difficulty exists in measuring the amount of kidney work by the product of renal activity, the urine, when one considers it independently of its relations to the system, and even more, for since catheterization of the ureters makes the separate col-

- lection of the excretion of each kidney possible, *we can also measure the amount of work of each organ.*

But practical difficulties stand in the way of this possibility built on purely theoretical grounds. These difficulties consist in the fact that, if one wishes to calculate the amount of substances eliminated by each kidney as a measure of kidney work, he must naturally do this over a long period—that is, he must leave the ureter catheter in position for a long time, eventually days. Such experiments have been made by other authors; we shall later often speak of their results. But although injurious consequences have not been reported from this procedure, still such a method appears to be a very delicate venture, exceedingly annoying to patients, and one which both physician and patient would decide to employ only in the most urgent cases.

In order to develop the method of catheterizing the ureters into a procedure which can be practically applied for functional kidney diagnosis, and which does not remain reserved for exceptional cases, we must certainly look about for another *modus procedendi*, a method which gives reliable results from relatively small amounts of urine, that is, when the ureter catheter needs to remain in place but a relatively short time, and which allows us to secure as much of an idea of the amount of kidney work, as we could from the excretion of each kidney collected for 24 hours and longer.

Almost no one to-day doubts that the small amounts of urine obtained by the ureter catheter suffice for the investigation of chemical changes or abnormal microscopic elements, and that in this way the diagnosis of the disease of a kidney is made possible in an anatomical sense; but the supposition however, that such small amounts are adequate to prove the power of kidney function, would, a priori, well be questioned.

This doubt was in fact justified when we came to express the absolute amount of kidney work in figures from the quantity of eliminated substances; for the quantity of excreted end-products varies from hour to hour according to the demands metabolism makes on the kidneys, and according as they are affected by ingestion and digestion of food, absorption, etc. From the amount of substances secreted during only a short period of time, no deduction can naturally be made as to the 24 hours, a period generally taken as a standard in experiments in metabolism.

But it is not a question with us finally of getting the absolute amount of the work of each kidney; we wish principally to know in what relation the work of one kidney stands to that of its sister organ, whether it participates equally in the total of work, or whether and to what degree the performance of one is superior to that of the other. Taking it for granted that normally the kidneys furnish at similar times a similar quantity and quality of excretion, it would be

enough if we examined the urine collected from each kidney during the same period of time, though short, with reference to the amount of eliminated constituents, and calculated from a contingent difference, the actual greater or lesser power of work of an organ.

The main question upon which rests a practical and promising method of calculating the work of each kidney, and upon whose negative or positive solution stands or falls the possibility of a functional diagnosis of kidney power as described, is as follows:

(a) DO BOTH KIDNEYS EXCRETE SIMULTANEOUSLY A PRODUCT OF SIMILAR CONCENTRATION?

Until recently, it was an axiom of physiology that both kidneys *excreted not simultaneously but alternately*. Ludwig says that when one lays free the ureter in dogs, and collects the urine separately from each kidney, one sees how now the right, now the left kidney excretes. Frédéricque reports from his experimental observations that periods of activity of the kidney alternate with those of relative quiet, and vice versa.

The statements in most physiological text-books are similar (Goll, Hermann, Grützner, Landois, etc.). But not only the quantity but also the quality of the excretion is reported to differ. The basis of all such opinions is the experiments on animals by Hermann, who laid free the ureters in large dogs, bound in

canulæ, and investigated the trickling secretion separately in reference to its quantitative composition. It proved that not only was the fluid discharged from each of both kidneys over a certain period, different, but that there were also noticeable distinctions in its concentration. The amount of urea as well as the sodium chloride varied more or less considerably.

These experimental investigations which for a long time represented the only material which existed to aid in the decision of the question of the similar or dissimilar secretion of both kidneys, were then corroborated through occasional conditions which were met with in cases of patients with ectopia vesicæ, or with women who had vesico-vaginal fistulæ.

We will mention of such accurately investigated and therefore reliable cases, without making any pretense of completeness, an observation of Samschin. This author, in the case of a woman with vesico-vaginal fistula, found in one instance that the number of contractions of both ureters observed through a certain period of time was entirely unequal, and that both kidneys excreted a different quantity of urine. A chemical examination performed only once showed, apart from a different specific gravity, unequal amounts of urea (95 and 85 mgr.) and of sodium chloride (68 and 65 mgr.). But these are only inconsiderable variations which possibly are partially due to errors in the experiment.

We possess a number of detailed investigations on this point performed by W. Zuelzer on a patient with *ectropia vesicæ*. A totally different condition of the excretion of both kidneys appeared. In 160 single observations, the composition of the urine on both sides was never similar, and it even showed differences which extended far beyond the boundaries of incidental errors of observation. The differences in the figures are very considerable: if one examines closely the table accompanying the work, one finds discrepancies of 50 per cent. and over in the amount of nitrogen in the excretion of both kidneys, and in the same way very striking differences appear in the amount of urine and its specific gravity.

Zuelzer sought to further prove that the excretory activity of both kidneys was totally different by testing their permeability for various substances, especially iodine preparations and salts of salicylic acid. Here also a remarkable time difference existed in the appearance of the substances tested in the urine of both sides, a dissimilarity as great as the relatively long period of 25 m.

From his series of observations, Zuelzer deduced "that even in a fully normal condition, the kidneys show qualitative and quantitative inequalities in excretion. This hypothesis is warranted, because such cases doubtless more nearly correspond to normal relations than is the case in animal experiments in

which the severe nature of the procedure must considerably alter the kidney activity."

We can readily agree to the latter statement, but it is also true that a case of congenital failure of bladder closure, such as the foregoing, can certainly not be looked upon as the type of a fully intact kidney activity. In fact Fürbinger in his participation in the discussion in the Medical Society which followed the announcement of the results secured in this way, called attention to the fact that it is possible, as often happens in congenital failure of bladder closure, that we have been dealing in this case also with congenital or acquired renal changes—atrophy, foetal lobe formation, infarcts, scar contractions—changes which were easily capable of explaining the otherwise remarkably large differences.

At any rate it is very difficult to imagine why the kidneys, which have a blood material of similar composition furnished them to work upon, should in normal circumstances be able to produce such different results. One could at best explain it if one was willing to suppose that the speed of the blood stream in both kidneys is different, that is to say, that in a given time a greater amount of blood is carried now to one, now to the other kidney.

But this also is not true: such an hypothesis can even be positively rejected. Bardier and Frenkel have just lately renewed Hermann's experiments. They

were first able to learn through exact physiological methods, that an alteration in the amount of blood carried to both kidneys does not exist. They have further proved—on animals—that the amount of urine simultaneously excreted from both kidneys is also equal, provided one avoids the experimental errors as submitted by the authors of the earlier experiments. To such sources of error belongs, for example, a different calibre in the canulæ introduced into the ureters; small mechanical obstructions in the ureter can also effect the amount of urine, and other similar factors. The conditions change, as Bardier and Frenkel find, when one excites the kidneys to greater excretion by artificial means, for example, by injecting solutions of salts. Then indeed now the right and now the left kidney can perform a greater amount of work. The authors believe however that the theory of an *alternating* work of the kidneys, under normal circumstances, must certainly be rejected.

By the aid of catheterization of the ureters we are now in a position to settle after a manner the question of the similar or dissimilar secretion of both kidneys, *in men*, wholly apart from the fact that it promises to clear up many matters in the physiology of the ureters, a subject little worked upon since the fundamental experiments of Engelmann; for this method allows us, without any procedures which exert a disturbing influence on kidney function, to study their

work as it is performed in normal conditions. To this degree the results obtained in this way are alone authoritative, and are naturally to be given preference in trustworthiness to those secured by experiments on animals with exposure of the ureters, or to data from pathological cases.

Our experiments give the following results:

1. The *amount of urine excreted* from both sides, collected for 20-40 m. is *occasionally exactly or approximately equal*. The records on this point appear in the patients' histories, reported later on. At all events it is not the exception. There are cases where the amounts of urine excreted from the two normal kidneys appreciably differ. The reasons for this are easily explained; and are the same as those cited in the animal experiments by Bardier and Frenkel: occasional obstruction of the narrow catheter, unequal calibres of the instruments, etc. We do not need to ascribe an importance to these discrepancies.

2. The question of the *concentration* of the urine is more important. We have examined its concentration along the following lines.

(a) With regard to the *total amount of nitrogen*.

(b) With regard to the *amount of its salts*, represented by the principal representative of the salts in the system—the *sodium chloride*.

(c) With reference to the *total amount of excreted molecules*, determined by the lowering of the urine's freezing point.

(a) The *amount of nitrogen*, measured in percentage, is to be considered as *absolutely equal* on both sides. Differences in the second decimal which occasionally appear in the following results naturally do not possess the least significance.

We cite here a few figures:

		Per Cent.		Per Cent.
Case	1.....N right side	=0.59	N left side	=0.58
"	9.....N " "	=0.65	N " "	=0.61
"	10.....N " "	=1.14	N " "	=1.12
"	15.....N " "	=1.96	N " "	=1.96
"	22.....N " "	=0.61	N " "	=0.61
"	25.....N " "	=0.49	N " "	=0.44
"	30.....N " "	=0.52	N " "	=0.53

(b) The *amount of salts* we estimated only during the first of the investigations in order to gain some idea about the matter. Later we gave up doing it, as it was naturally impossible to determine quantitatively all the elements which interested us from the relatively small amount of excretion we had at our disposal. The cases investigated show on the whole a similar equality for both sides.

Here, too, in place of further discussion, we let the figures speak for themselves.

		Per Cent.		Per Cent.
Case	1.....NaCl right side	=1.19	NaCl left side	=1.35
"	7.....NaCl " "	=1.28	NaCl " "	=1.14
"	9.....NaCl " "	=1.19	NaCl " "	=1.25
"	10.....NaCl " "	=1.10	NaCl " "	=0.97
"	12.....NaCl " "	=0.48	NaCl " "	=0.46
"	15.....NaCl " "	=1.08	NaCl " "	=1.05

(c) *The molecular concentration*, measured by the lowering of the freezing point, and which as we have explained before, as a measure of the total of the molecules contained in the urine without regard to their quality, furnishes us the most comprehensive idea of its composition, gave the following results.

Case	I	Δ	right side.....	Per Cent.	Δ	left side.....	Per Cent.
				1.59°			1.58°
"	9	"	"	1.42°	"	"	1.42°
"	10	"	"	1.48°	"	"	1.48°
"	27 ¹	"	"	0.50°	"	"	0.50°
"	39	"	"	1.06°	"	"	1.05°
"	47 ¹	"	"	0.22°	"	"	0.22°

Here also one sees a total agreement.

We must here discuss briefly the values obtained for Δ , since they corroborate what we have previously stated. We see, in the first place, that the majority of the cases show high numerical values for Δ , over -1° , which was mentioned as characteristic of normal kidney secretion.

We further see *how low values for Δ can occur with diluted urine even in cases of healthy persons*, and how *in our investigations we must always take into account the factor of a contingent dilution* if we are to draw a conclusion as to an adequate renal function from the figures obtained for it.

The facts established by us in regard to the similar *concentration* of the excretion produced by each kid-

¹ Urine greatly diluted.

ney, hold true, however, only when an *absolutely simultaneous collection* of the urine is carefully adhered to. We have on a certain occasion stated¹ that collections of the secretion of each kidney made immediately after one another, that is, separated by intervals of from 20–30 m., caused no great differences to appear. We at that time had observed several such cases, but had no opportunity to collect further evidence on the point because, where possible, we always employed a *simultaneous* collection. Still in the question of the molecular concentration, greater differences also seem capable of occurring. At least, from a work as yet unpublished by Illyes in Koranyi's clinic in Budapest (Ueber den Ureteren Katheterismus im Dienste der functionelle Nierendiagnostik) we take the following results most kindly placed at our disposal, of cases with healthy kidneys, in which the collection of urine was made from *one ureter after the other*:

	Right Side Δ.	Left Side Δ.
1. Healthy Kidney.....	— 1.91°	— 1.30°
2. " " 	— 1.86°	— 1.31°
3. " " 	— 1.11°	— 1.85°
4. " " 	— 1.10°	— 1.46°

The interesting physiological question as to the similar or dissimilar secretion of both kidneys is thus unequivocally answered by the aid of ureteral cathe-

¹ Cf. P. F. Richter, Discussion in der Berliner med. Gesellschaft vom 14 Dec., 1898.

terization in the sense that *the similar secretion of normal kidneys can no longer be doubted.*

This conclusion, however, has a wide-reaching practical significance, because by reason of this fact we are now more than ever in a position to calculate from the secretion of each kidney collected simultaneously, and during only a relatively short time, what proportion the work of each kidney bears to the total amount.

We will now still further describe the single methods by which in conjunction with the catheterization of the ureters the amount of work of each kidney may be estimated.

(b) THE ELIMINATION OF NITROGEN BY EACH KIDNEY.

The quantitative determination of the *urea*, that is, of the *N-total* in the excretion of each kidney, is the most obvious and accordingly the first method employed in connection with catheterization of the ureters in securing information as to the work of each kidney.

As early as 1897, such investigations were published by Guyon and Albarran. The results at any rate were generally obtained by conducting outside the body, by means of a ureter catheter, and for a period of from several to twenty-four hours, the urine of the kidney supposed to be diseased. The bladder urine during this time served as a measure of the work of the other kidney.

Our method, as is easily evident, is to be preferred, since, without too great annoyance to the patient, it allows us to just as accurately learn the conditions of the N elimination of both kidneys.

We will later come back to a consideration of the results obtained in this way, and their diagnostic application when we report the single histories of the patients, and now we wish only to speak in general of the value of the method. The elimination of the waste products of proteid metabolism is certainly a very important task of the kidneys, but by no means the only one. It would therefore be arbitrary and biased to measure the amount of work done by the kidneys only in relation to the N elimination.

Although this factor is valuable and important, it attains its true significance only when taken in conjunction with others: taken alone, it can lead to false conclusions as to the kidney's work.

What we have said of nitrogen also holds true, as we have already stated, for other *single* representatives of the eliminative work of the kidneys, such as the chlorides, etc.: we therefore need say nothing further of them.

(c) THE DETERMINATION OF THE MOLECULAR CON-
CENTRATION OF THE EXCRETION OF
EACH KIDNEY.

In treating of the diagnostic significance of cryoscopy in the recognition of kidney affections, we have

emphasized the fact that under certain limitations which were explained, renal disease, that is, disease of both kidneys, discloses itself in the freezing point of the urine excreted. On the contrary, as we will show in more detail, cryoscopy of the *total amount* of urine gives us no information concerning a *unilateral* kidney disease, or at least does not necessarily do so.

An observation which Moritz reports is very instructive on this point. In a case of right kidney tumor, numerous determinations of the freezing point of the urine had shown normal values (that is, more than -1° , the author does not give the exact figures), so that one was led to suppose an adequate compensation existed on the part of the other kidney. At the operation however the left supposedly normal kidney was found greatly diminished in size, hard and of uneven surface. Accordingly the extirpation of the right kidney burdened with the tumor was abandoned.

Apparently, as also Moritz supposes, the normal remaining portions of the right kidney could so adequately perform their function that a full compensation existed.

There could hardly be a case better fitted to bring out clearly the value of catheterization of the ureters in the diagnosis of renal function. In this case a wholly sufficient kidney activity was present—the examination of the blood concentration in the manner already explained had also presumably given a normal

value, and only encouraged one to operate. Nothing pointed to a disease of the second kidney. On the contrary the matter could have been at once cleared up by catheterizing the ureters: a determination of the freezing point of the separately collected urine would have certainly shown that the diseased kidney was adequately functioning while the supposedly normal kidney was doing inadequate work. This would have made the exploratory operation unnecessary.

Two years ago we were the first to emphasize how valuable in determining the work of each kidney is a combination of ureter catheterization with a calculation of the molecular concentration, that is, the cryoscopic investigation of the separately collected urine, and how only by this union of methods the modern achievements of renal diagnostic surgery can be attained. We have expressly stated also that "while with normal kidneys this same molecular concentration determined from the simultaneously collected urine is so valuable a measure of the physical work of the organ, with unilateral renal disease, considerable differences between the normal and diseased side are to be found." Since we made these statements numerous investigations on this point have been undertaken by other observers, and we collect for inspection in the following table the cryoscopic results to which we have been able to get access, reported by Albarran, Kümmel, and Illyes (Budapest).

142 FUNCTIONAL KIDNEY DIAGNOSIS.

Observer.	Diagnosis.	Freezing Point.	
		Left Kidney.	Right Kidney.
		Molec. Concent. = Δ .	
1. Albarran	Intermittent hydronephrosis	-0.66°	-0.82°
2. "	Bilateral pyelitis.....	-1.17°	-1.82°
3. "	Left renal tuberculosis	-0.70°	-0.81° ⁰¹
4. "	Left renal tuberculosis	-0.61°	-0.69° ⁰²
5. "	Calculus of left kidney	-1.18°	-1.52°
6. "	Tumor left kidney....	-0.70°C.	-1.48° ⁰³
7. "	Right pyonephrosis...	-0.81°	-0.74° ⁰⁴
8. "	Bilateral pyonephrosis	-0.50°	-0.53° ⁰⁵
9. "	Right renal tuberculosis	-0.60°	-0.53° ⁰⁶
10. "	Left renal tuberculosis	-0.64°	-1.04°
11. "	Left movable kidney..	-1.41°	-1.55°
12. "	Right pyonephrosis...	-1.37°	-0.55°
13. Kummel	Chronic parenchymatous nephritis.....	-0.19°	-0.75° ⁰⁷
14. "	Left paranephritic abscess	-1.44°	-1.54°
15. "	Right movable kidney with hydronephrosis	-0.42°	-0.36° ⁰⁸

¹ As a result of the discovery of the inadequate function of the right kidney, the case was not operated on.

² Not operated on for the same reason.

Nephrectomy.

⁴ Not operated.

⁵ First left, then right nephrotomy.

⁶ Nephrectomy,—in right kidney, tubercles and diffuse nephritis.

⁷ δ (in blood) = -0.60°.

⁸ Not operated.

Observer.	Diagnosis.	Freezing Point.	
		Left Kidney. Molec. Concent. = Δ.	Right Kidney. Molec. Concent. = Δ.
16. Kummel	Left renal tubercu- losis	—0.81°	—0.81° ¹
17. “	Right pyelonephritis..	—0.65°	—1.75°
18. Illyes (v. Koranyi)	Renal tubercu- (later)	{	—1.37°
	losis		—0.80° ²
19. “	“ Renal tuberculosis....	—0.52°	—0.70°
20. “	“ Left pyonephrosis....	—0.81°	—1.96°
21. “	“ Left pyonephrosis....	—0.70°	—1.52°
22. “	“ Right renal carcinoma	—1.41°	—0.68°
23. “	“ Interstitial nephritis..	—0.69°	—0.42°
24. “	“ Right renal fistula (fol- lowing nephrotomy)	—1.40°	—0.57°

A study of this table shows—and our own experiences, which we will later report collectively, fully agree—that an inadequately functioning kidney as opposed to a healthy organ, reveals itself in an appreciable difference in the lowering of its freezing point. A portion of the results, those of Albarran, were obtained by the method of determining the molecular concentration by leaving the ureter catheter in position for twenty-four hours. This is by no means necessary, for, as we found, the molecular concentration of the excretion of normal kidneys simultaneously collected for a period of twenty to thirty minutes, is for practical purposes absolutely the same, and thus an appreciable difference in the freezing points of both is in

¹ Not operated.

² Autopsy confirmed diagnosis of tuberculosis of both kidneys.

itself enough to make a diagnosis of abnormal renal function.

The diseased and functionally injured organ shows, as we further notice, a lowering of the freezing point which is always less than -1° . An adequate activity of the other kidney, on the contrary, is to be assumed when its freezing point is between -1 and -2° C.

A low molecular concentration, less than -1° , found in the urine of each kidney, is proof of an inadequate activity of both kidneys, presupposing however that no large fluid ingestion has taken place. Of course these sources of error will make their influence much more felt if, according to our method, only the urine excreted during a short time is collected, than when we are dealing with a determination based on the twenty-four-hour amount. In diluted urine, as we have already repeatedly said, low figures for the freezing point for both kidneys have no diagnostic significance. How far the method of measuring the work of each kidney from the degree of the lowering of the freezing point harmonizes with other methods of determining the same factor will be explained in connection with our cases.

(d) THE METHYLENE BLUE ELIMINATION OF EACH KIDNEY.

Albarran and Bernard have used Achard's methylene blue test in connection with ureter catheteriza-

tion, and in a number of unilateral kidney affections have studied the difference in the elimination of the dye according to kidney functional power. We can at once admit that in this connection the methylene blue test furnishes more exact results than without the use of the ureter catheter. But in spite of that we cannot pass over a number of objections. The reasons already stated in a former chapter against the use of methylene blue as a *general* indicator of renal function also hold good in this experimental method—moreover the French authors themselves are aware of them.

In addition, however, we have the fact that the method by which the elimination of methylene blue must be tested, even if it is to give reliable results limited only in the direction of the objections mentioned, is not well adapted for use in connection with ureter catheterization. We must test, as has before been explained, not only the time of beginning of the methylene blue elimination, but also its cessation, its course, and its intensity. To fulfill all these conditions, the ureter catheter must be left in position for days at a time, which as a matter of fact was what was done in several cases of Albarran and Bernard's. Such a heroic method would possibly be justified if the results it gave could be obtained by no other means. But, as the caretaking investigations of Albarran and Bernard show, the methylene blue test appears in no respect superior to other diagnostic methods; on the

contrary, it is capable of serving only as a proof of the permeability of the kidney for the substance used. It is thus inferior to the method of determining the freezing point which shows the renal permeability for solid molecules in general, and so we believe that the methylene blue test will not gain, even in this combination, practical importance, and that we can dispense with it. In fact Albarran also (see Discussion in the "Société de Chirurgie," June, 1900) seems lately to have retreated from his opinion of the worth of the methylene blue test.

(e) THE PHLORIDZIN METHOD.

The property of phloridzin, a glucoside used in treatment many years ago, and then forgotten, of producing the elimination of sugar is known to have been discovered by von Mering. von Mering at the same time added a statement which placed this glycosuria in a rather contrasting position to all known up to that time, namely, that the sugar elimination was not accompanied as usually is the case by a hyperglycæmia, but that the amount of sugar in the blood remained normal, and at times was even diminished. These statements have several times been put to test, and have been corroborated on animals by an overwhelming majority of investigators, as Quinquaud, Minkowski, Levène, Hedon.

As to the conditions existing in men, we have state-

ments by Delamare. Out of nine experiments, two, after the subcutaneous injection of 15-50 mgr. phloridzin, showed a minimal increase of blood sugar, which however might be due to errors. In the remaining cases a diminution appeared, at times to a very appreciable degree.

This variation from the conditions usually found showed that other forces must come into play in the production of this glycosuria—and it was soon discovered, in attempting to probe more deeply into the reasons for its existence, that the *kidneys* were the organs really at the bottom of the matter. At least, as Minkowski first proved, after extirpation of the kidneys, or tying off the ureters, the blood, which formerly had its sugar taken away by phloridzin, regains its normal amount, and although it could be claimed that fully shutting off the kidneys is too serious a procedure to allow results to be obtained to which no objection could be made, Zuntz showed the exact reasons for the existence of the renal glycosuria. He introduced canulæ into the ureters of a dog, then laid free the kidney, and injected phloridzin into the renal artery. Sugar appeared first, and in greater amount from the ureter of the kidney into which the phloridzin was injected, so that *the local effect of phloridzin on the kidney parenchyma* itself could no longer be doubted.

There are still various opposing theories as to the

manner in which this effect of phloridzin on the kidneys is produced. According to one hypothesis, the kidney, through a special specific irritation which phloridzin exerts on the renal cells, draws from the blood the previously formed sugar, and hence its diminution in the blood. According to others (Levène, Paderi) the kidney itself forms the sugar, an opinion principally based on the fact that under the influence of the phloridzin, the work of other glands also, as the mammary glands, is increased. We wish to say briefly that we regard the first opinion as the correct one, while important considerations seem to us to oppose the second. But it is irrelevant to the following views which opinion we adopt. Both agree in this point—which is for us the main thing—that *the kidneys are the principal point of attack of the phloridzin action, and that without their activity, the sugar elimination does not take place.*

If now phloridzin-glycosuria is dependent on a function of the kidneys, it will be easy to investigate how this function changes in renal disease, whether and how a modification of sugar elimination appears, and this is also interesting in reference to the theory; for it is naturally an added proof that the elimination of the sugar takes place in the kidneys, if it goes on in a different way in a diseased kidney than in a normal organ.

To this point of view the first experiments which

related to this question were directed, and first on animals: Schabad¹ produced nephritis artificially on dogs, but in spite of this observed the phloridzin develop its effect. Also Hellin and Spiro² found after injury to the kidney parenchyma an only inconsiderable influence was exerted on the phloridzin-diabetes, and only with toxins such as cantharides, which produced the most severe lesions affecting all portions of the renal tissue was the glycosuria wholly absent.

G. Klemperer³ was the first to use phloridzin on human kidney patients, with the especial view of proving in this way the occurrence of a so-called renal diabetes, that is, a glycosuria which originated in the kidneys. The fact was for the first time established that in cases of contracted kidney, the glycosuria was absent, but at all events, not without meeting vigorous contradiction. In opposition to it, Magnus Levy⁴ maintained that the fundamental distinction which Klemperer asserted to have discovered in the effect of phloridzin in normal individuals and in nephritics (that is, patients with granular atrophy) does not exist. He did not give the phloridzin as did Klemperer, by mouth, but subcutaneously, and thus prevented the phloridzin from reaching the kidneys in an already

¹Wiener med. Wochenschrift, 1892.

²Archiv für Exp. Pathol., 1897.

³Verein f. innere Med., 1896.

⁴Verein f. innere Med., 1896.

broken up form incapable of taking effect, and he thus discovered that patients with contracted kidneys and also other renal diseases reacted with glycosuria just as well to phloridzin as normal individuals.

Experiments of this sort were then further undertaken on a large scale by Achard and his scholar Delamare, but with another question in view totally different from that of the previously mentioned authors. Achard took for granted the existence of a renal phloridzin-glycosuria; he decided that if this glycosuria is dependent on a *normal* renal function, every variation from normal must also disclose itself in a modification of the phloridzin-glycosuria—at least using modification in the widest sense of the word. Purely theoretically the glycosuria could be increased, diminished, or finally totally absent. According to Achard he succeeded in determining *quantitatively* the difference in ph-sugar elimination in normal and diseased kidneys. He showed secondly however that the *amount* of phloridzin administered played an important rôle. Klemperer, as well as Magnus Levy and the other authors mentioned, worked with very large doses, 1 grm. and over. Achard and Delamare show that only a small portion of this amount is sufficient. For it is at once evident that if one wishes to study the reaction of a normal organ to an irritant and to compare it with that of a diseased organ, one should not work with maximal amounts of irritants, but that he

will obtain comparable results by using simply increasing doses.

From this point of view the French authors have studied in detail the effect of phloridzin on a large amount of material embracing the various renal as well as other diseases. In this they paid attention not only to the amount of sugar eliminated, but as in the case of methylene blue, they have followed out its *course* and *duration*. Their results, as far as they interest us, are briefly as follows:

Among 62 observations in which the phloridzin glycosuria took its regular course, and was of normal amount, there was only one case of renal disease, and that one unilateral (renal tuberculosis); the anatomical normal condition of the kidneys was proved by autopsy, at least in a number of the cases.

A *diminution* of the glycosuria or even its total disappearance occurred in 55 cases; *among these were only 6 which did not show manifest symptoms of renal disease* and a portion of these at any rate had signs of arterio-sclerosis; in the other 49 were comprised the most varied stages of acute and chronic nephritis. Here too a portion of the diagnoses were corroborated by autopsy. It was noteworthy in one case that a negative result in the phloridzin test corresponded to an extensive disappearance of renal parenchyma, and that further in cases where the pathological process was capable of recovery, as in acute nephritis, the

ph-glycosuria which was absent at the acme of the disease gradually reappeared, and furthermore with the advancing convalescence took its regular course.

The modification of the ph-glycosuria which expressed itself in an increased amount and a long course is illustrated by 23 observations. Among them are also 4 cases of chronic nephritis, but Achard and Delamare emphatically state that it was due to complications (light grade diabetes, intercurrent influenza), so that these cases are not considered.

The authors conclude from their investigations that *in general, diminution or total absence of the ph-glycosuria is characteristic of kidney diseases*, a deduction which seems sufficiently justified by their results.

In order to judge the value of the phloridzin-test, the French authors compare its results with those obtained with methylene blue in testing kidney function. The findings do not always harmonize: the methylene blue elimination was occasionally prolonged and delayed where the ph-glycosuria exhibited a normal type, and vice versa, the passage of the methylene blue was often unimpeded in cases where the sugar elimination following phloridzin was diminished or wholly absent. Especially in cases of acute or sub-acute nephritis where the permeability for methylene blue, as we have previously seen, was retained or increased, the lack of agreement with the negative results of the phloridzin test was striking.

We will later on return to this point of incongruity, which rests on the totally different physiological value of the two methods—for they cannot even be classed together. Here we will next briefly discuss the question: Does the phloridzin test in the form employed by the French authors secure for us information as to the adequate or inadequate renal power of work?

Achard and Delamare are openly not of the opinion that the phloridzin test is entitled to any especial position: they regard it as a method of examination less valuable than the older methods, among which they give especial prominence to "the albumen test" and "the methylene blue test": they regard it as in a certain degree supplementary to these, but no more. Only they emphasize that it is not so much anatomical changes in the kidneys which are indicated by it, but more especially disturbances, even transitory, of a functional nature.

At all events we can just as little obtain an answer to the question whether the kidneys are sufficient or not by this method as from all the others previously discussed which consider only elimination by the urine. Apart from the general reasons explained in detail in the foregoing chapter, in this especial case we get no help, because it seems impossible to assign a normal value to the phloridzin-glycosuria, that is, to the amount of sugar produced and eliminated by normal kidneys by a definite amount of phloridzin in a definite

length of time. Achard and Delamare report as an average amount of sugar elimination as they have found it in normal kidneys 1.36 grm.

But this average value is obtained from figures which vary greatly. If one looks through the histories of the patients furnished by the authors, one sees that in cases of patients without any kidney disturbance this figure is as low as 1 grm. as well as equally higher than the given normal value.

If such great variations exist, it is at once clear that no conclusion as to the degree of kidney disturbance is to be drawn from the *absolute* amount of glycosuria, and only when the sugar elimination is minimal or is totally absent can a considerable degree of renal injury be deduced. We may certainly raise the objection that in such cases the test was unnecessary, because nearly always the severely affected kidney function expressed itself more clearly through other clinical signs, more than all however by albuminuria and other similar symptoms. Still in this connection Achard and Delamare can show histories of cases where nothing, especially no albuminuria, points to a severe kidney disease, but in which the phloridzin test is negative, and in which it is actually the only indication of an advanced renal sclerosis. Thus two cases of the French authors of gastric carcinoma, where the urine contains no trace of albumen, the phloridzin-injection caused no glycosuria, and in fact the autopsy disclosed in both cases

severe kidney changes (interstitial nephritis with transformation and atrophy of numerous glomeruli).

Such cases, even though they occurred seldom, would alone suffice to secure for the phloridzin-test a certain clinical diagnostic consideration, even though nothing is proved of its importance in determining the point which principally interests us—that of kidney function.

Among the cases on which Achard and Delamare have based their conclusions, already mentioned, is another such case of *unilateral* kidney disease, a right renal tuberculosis. The phloridzin-glycosuria showed 1.75 grm. of sugar eliminated, a value which according to Achard fell wholly within normal limits. Just as we stated of the determination of the molecular concentration, so in the phloridzin test also, a unilateral kidney disease is not necessarily disclosed from an examination of the total amount of urine, partially in consequence of compensation performed by the remaining portion of normal functioning parenchyma of the diseased kidney, partially in consequence of adequate substituting activity of the sister organ.

And thus in just this respect, the phloridzin-test can furnish us very valuable information: *it will imply a real advance in functional kidney diagnosis, as we intend in what follows to prove, if we seek to use it as a measure of the work of each kidney in conjunction with catheterization of the ureters.*

Let us consider once again the manner in which phloridzin produces its effect: it causes an autonomous activity in the renal cells, their withdrawal of sugar from the blood. The more renal cells present, so much greater, *ceteris paribus*, will this activity be. On the contrary a loss of secreting parenchyma will make its influence felt in a diminution of this activity, that is, the amount of sugar elimination will be directly proportional to the amount of kidney parenchyma present which is capable of function. In this instance the loss of a portion will not necessarily, at all events, produce any effect, so long as it is covered up by compensatory hypertrophy of the remaining tissue—hypertrophy here being used not alone in an anatomical but also a functional sense.

The phloridzin test thus gives us a *general* indication of how large an amount of functionable material is present; but it gives us no information in particular as to the value of this material. We have had many opportunities of stating that the kidney parenchyma has not an equal physiological capability for the elimination of single substances, that the selective power of the renal cells by no means is always similar for every element. In addition to this every pathological renal process attacks the single divisions of the kidney in a totally different and unequal manner, and so the power of eliminating one component may be retained, but for another it may have severely suffered. There-

fore the eliminated amounts of *single* constituents in kidney diseases can never be reduced to an accurate formula; they will much rather, in the various grades of functional renal disturbance, present a confused kaleidoscope picture, which continually changes according to the substance examined. With the same degree of excretory disturbance, the elimination of methylene blue may be prolonged, and that of any other salt, taken as an example, may be increased, and vice versa.

The phloridzin-test is not to be classed with all the other methods of testing renal elimination; it measures *the amount of working parenchyma present*, and so *indirectly also the amount of kidney work*, and even though it must be admitted that this renal power is determined from one single function alone, and one which under normal conditions is foreign to the kidney—the separation of sugar from the blood—still through this test a *general* measure of kidney activity seems to have been acquired, and one easily expressible in figures.

In using it in connection with ureteral catheterization, still another circumstance aids us. *The sugar elimination after the injection of phloridzin appears very quickly, and also terminates very rapidly.* The whole phenomenon is completed in about three hours; in this time it is generally over, while the beginning of the glycosuria is to be detected about fifteen to

thirty minutes after the ph-injection. If we wished in this instance also, as Achard has done in the methylene blue test, to study the *beginning, duration* and *amount* of elimination of *each* kidney, we would only have to leave the ureter catheter in position for about three hours. This would be a period certainly troublesome to the patients, but still bearable when one considers how long French authors have allowed their catheters to remain without seeing injurious results.

However, we have become convinced that for our purposes, it is chiefly only the *amount* of sugar elimination which is to be considered, and thus we are fortunate enough to be relieved of the inconvenience of collecting separately the kidney excretion for several hours. For here too the important fact appears that *both normal kidneys excrete from phloridzin the same amount of sugar at the same time*, and so it is immaterial in what phase of the phloridzin effect the urine is examined, whether at the beginning when the glycosuria is relatively strong, or toward the end, where it is relatively weak: the amount of sugar contained is always the same on both sides. For practical reasons however it is advisable to perform the test in the first stage of the ph-effect, that is, thirty minutes to one hour after the injection.

This *modus procedendi* is advantageous because in the first place contingent differences between the normal and the diseased kidney are naturally much greater

at the acme of the sugar elimination, than at its close, and secondly the quantitative estimation of the sugar is easier when one deals with relatively larger amounts in the urine to be examined than when they are minimal, as is the case toward the close of the effect of the phloridzin. We can get results in the former instance, at least frequently, by polarimetry, while in the latter we must resort to lengthy chemical methods (as given by Knapp).¹

We also wish in this connection to state that phloridzin injections in the doses employed by us are absolutely non-injurious. We have never been able to see any disadvantageous result in all our numerous experiments.

¹Lately we have also used the Lohnstein fermentation saccharometer several times. The results agree with those obtained by the other method.

IV.

OUR EXPERIMENTAL RESULTS.

We report in what follows the cases we have examined since September, 1898, some in outline, others in more detail. The first 20 show many deficiencies, as we at that time were still developing the method, and met with many difficulties. Colleague Roth (Budapest) most kindly aided us in the examination of a number of these first cases. In them we have also calculated the amount of NaCl excreted. After we had become convinced however of the unimportance of this factor in pathological cases, we discontinued it.

The same method of examination was pursued with all patients. They received one-fourth to one-half hour before the investigation 0.005 phloridzin subcutaneously (phloridzin obtained from Merck in Darmstadt. Only the very last cases were treated with the Kahlbaum preparation). Several were given more, up to a double dose, and in these cases it is especially so stated. Several were not examined until one to two hours after the phloridzin injection, and a remark to this effect is also inserted in the cases concerned.

As far as possible both ureters of the patients were catheterized. It is easy to understand that in many

instances, especially severe cases with cloudy bladder contents, great difficulties were occasioned. These were, however, nearly always overcome by previous cleansing of the bladder.

Still in certain single cases we were forced to limit ourselves to the introduction of one ureteral catheter, while another catheter lay in the bladder. We have often satisfied ourselves that as soon as one pushes up the ureter catheter high enough nothing flows along it into the bladder, so that the bladder urine can be considered as coming purely from the other kidney. It is especially so stated in the four cases where we employed this expedient. We have already pointed out (see page 55) that in order to avoid every danger in catheterization of the ureters, it will be the rule to proceed in this manner, especially in unilateral diseases.

The greatest value is to be attributed to the simultaneous collection of urine from both kidneys. This was not always done in the first cases, as we had not then sufficiently realized its importance. *The whole method is based on the synchronism of the collection of the urine, and only one who can carry this out faultlessly can reckon on obtaining sure and trustworthy results.*

Most of the examinations were made with the old Casper ureter-cystoscope, in which the catheter can be changed for the two ureters. We take a familiarity

with the construction of the instrument for granted and content ourselves in stating only its two chief principles. *First the advancing ureter catheter must have a regulable curve.* This is not only necessary in order to be able to introduce it into the ureteral opening, but also after it has entered the mouth of the ureter, to be able to push it up higher, without causing lesions. For if it held the curve which was necessary for entrance, in pushing it further up it would continually bore against the wall with its point. The bend generally necessary to its introduction must later be straightened.

The contrivances of the Casper instrument for this purpose are well known. We will only say that *the catheter should never be pushed up higher than necessary for the purpose at hand.* If one catheterizes both ureters simultaneously, it is sufficient to leave the catheter in the lowest portion of the ureter. If, on the contrary, one has one catheter in the ureter and the other in the bladder, the former must be pushed up somewhat higher, a thing one has no hesitation in doing if one is dealing with the diseased side, for if the ureter catheter lies in the portion of the ureter near the bladder, a certain amount of urine enters the latter now and then along the catheter. We are now working, as is known, with thicker catheters, up to 6-8 Charrière scale. These still more surely than was the case up to now prevent urine from flowing along the ureter catheter into the bladder.

The second peculiarity of the Casper instrument consists in the following: after the catheter has been introduced into the ureter, and while it lies in position, it can be raised out of the canal of the instrument by an appropriate contrivance, so that this canal is now free for the second catheter to be introduced into the other ureter. The first ureteral catheter then lies partially between the metal instrument and the wall of the urethra.

In this way it is possible to have both catheters in the ureters simultaneously if the narrowness of the urethra does not present a hindrance. This however is often the case: for a considerable calibre of the urethra is needed to receive the ureter cystoscope and the ureter catheter in addition. With this occurring so often we met with difficulties, and it was impossible to avoid small urethral lesions. That led us to *so construct a cystoscope as to have from the outset two canals instead of one, so that one could, without changing, introduce one catheter after the other into the two ureters.* The construction of this ureter cystoscope caused little difficulty. In the movable and removable cover *D* (see Fig. 2) by which the curve of the catheter is regulated, two canals were inserted which provide room for two thin catheters. The canals for the catheters *C* and *C'* do not need to extend to the point of the instrument, but terminate about 10 cm. in front of the cover-slot. This instrument thus has provision

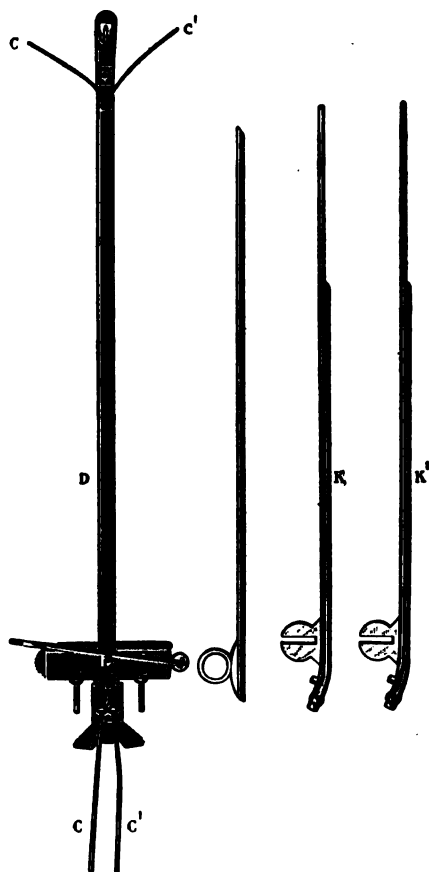


FIG. 2. Casper's Ureter-Cystoscope, for the simultaneous catheterization of the ureters.

for three different methods of catheter introduction. It can be used with the tube *K* for a thin catheter, with tube *K'* for a thick catheter, and with the double tube for two thin catheters. Since thick catheters possess an advantage, the arrangement for two thin catheters serves only for our present purpose—"the simultaneous collection of urine from both ureters." In employing it, it is also unnecessary to go higher than 5 cm. into the ureter with the catheter.

We append the cases examined:

No. 1. *St. Urethritis.*

	R.	L.
Specific gravity.....	1024	1021
Molecular concent. (Δ).....	—1.59°	—1.58°
NaCl	1.19%	1.35%
N	0.595%	0.581%
Albumen	nil	nil

No. 2. *Right tubercular pyonephrosis. Left amyloid kidney.*

	R.	L.
Amt.	—	21 c.c.
Spec. Gr.....	—	1022
Δ	—	—1.0°
NaCl	—	0.128%
N	—	0.08%
Albumen	—	1.75%

11. XI. 24 hr. amt. urine = 1,300 c.c. Δ —0.68°, NaCl 0.36%, N 0.59%, albumen 1.37%. Total eliminated urea 16 gm. NaCl 4.6 gm.

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No. 3. W. *Right tubercular pyonephrosis. Left amyloid kidney.*

	R.	L.
Amt.	6 c.c.	16 c.c.
Δ	—	—1.11°
NaCl	—	0.585%
N	0.17%	0.707%
Albumen	0.95%	1.5%

15. XI. First left ureter, then right catheterized. Right ureter at times plugged with masses of pus.

No. 4. J. *Albuminuria cyclica.*

	R.	L.
Spec. Gr.	1006	1007
Δ	—0.37°	—0.30°
NaCl	0.316%	0.175%
N	0.231%	0.203%

2. XII. 98. Urine diluted from patient's drinking one-half bottle mineral water. Collected 10 m.

No. 5. X. *No diagnosis.*

	R.	L.
Amt. 25 c. c.	Produces no excretion.	
Δ	—1.63°	
NaCl	1.23%	
N	0.805%	

14. XII.

No. 6. Mrs. G. *Cystitis levis.*

	R.	L.
Amt.	18 c.c.	20 c.c.
.....	—0.21°	—0.30°
NaCl	0.222%	0.257%
N	0.126%	0.168%

17. XI. Successive catheterization. Mineral water.

No. 7. Mrs. Sch. *Neuralgia vesicæ*.

	R.	L.
NaCl	1.287%	1.14%
N	0.707%	0.672%

18. XI. Empty stomach. Carbonated water.

No. 8. M. *Contracted kidney*.

	R.	L.
Δ	-0.94°	-0.44°
NaCl	1.04%	0.456%
N	0.064%	0.210%

26. XI. Successive catheterization. Diluted urine.

No. 9. Kn. *Urethritis*.

	R.	L.
Amt.	33 c.c.	36 c.c.
Δ	-1.42°	-1.42°
NaCl	1.19%	1.25%
N	0.651%	0.616%

9. XII. Simultaneous catheterization. Empty stomach.

No. 10. H. Kr. *Urethritis*.

	R.	L.
Amt.	20 c.c.	20 c.c.
Δ	-1.58°	-1.48°
NaCl	1.10%	0.97%
N	1.141%	1.127%

12. XII. Stomach empty.

No. 11. Mrs. H. *Right pyonephrosis (tubercular?)*.

	R.	L.
Amt.	40 c.c.	42 c.c.
Spec. Gr.	1012	1010
Δ	-0.48°	-0.78°
NaCl	0.86%	0.74%
N	0.322%	0.39%
Albumen	0.4%	Traces

δ (molecular concentration of the blood) = -0.58° .

4. II. 99. Urine very purulent, tinged with blood. Sediment: leucocytes, epithelium, few red blood corpuscles.

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No. 12. Mrs. H. (Professor *Rotter*.) *Cystitis*.

	R.	L.
Amt.	38 c.c.	21 c.c.
Spec. Gr.....	1022	1011
Δ	-0.46°	-0.43°
NaCl	0.48%	0.46%
N	0.392%	0.336%
Albumen	Traces	
$\delta = -0.56^{\circ}$		

Occasional epithelial cell and leucocyte.

8. II. L. Few leucocytes and epithelium, occasional red cells.

No. 13. H. *Right hydronephrosis with calculi*.

	R.	L.
Amt.	16 c.c.	20 c.c.
Δ	—	-0.86
N	0.238%	0.51%
Albumen	0.3%	0.1%
δ	—	$-0.58^{\circ} - 0.59^{\circ}$

9. II. L., leucocytes, epithelium, red blood corpuscles; one granular cast, small red cells.

No. 14. D. *Pyelitis dextra levis*.

	R.	L.
Amt.	17 c.c.	18 c.c.
NaCl	1.92%	1.84%
N	1.709%	0.51%
$\delta = -0.57^{\circ}$		

Leucocytes.

No. 15. A. *Convalescent pyelitis*.

	R.	L.
Amt.	32 c.c.	32 c.c.
NaCl	1.08%	1.05%
N	1.96%	1.96%

Simultaneously collected.

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No. 16. St. *Bilateral pyelitis.*

	R.	L.
Amt.	20 c.c.	12 c.c.
N	0.637%	0.343%
$\delta = -0.57^\circ$		

No. 17. B. *Nephralgia dextra-renal colic.*

	R.	L.
Amt.	24 c.c.	35 c.c.
Δ	-0.85°	-1.53°
NaCl	1.39%	2.5%
N	0.42%	1.38%
$\delta = -0.55^\circ$		

6. IV. Nephrotomy performed on account of suspected calculus. None found. Recovery.

No. 18. E. *Right nephrolithiasis.*

	R.	L.
Amt.	30 c.c.	20 c.c.
Δ	-0.71°	-1.55°
NaCl	0.95%	1.72%
N	0.343%	0.539%
$\delta = -0.58^\circ$		

12. IV.

No. 19. *Tubercular pyonephrosis or perinephritic abscess.*
Contracted bladder.

$$\delta = -0.57^\circ$$

26. IV. Nephrotomy, later nephrectomy.

No. 20. T. (Professor Kocher, Bern.) *Tumor left kidney.*
(Klin. Behandlung 58.)

	R.	L.
Δ	-2°	—
NaCl	1.0764%	—
N	0.469%	—
$\delta = -0.56^\circ$		

19. X.

Two years ago patient had blood in his urine for the first time: the hemorrhage was over after 24 hours. In February, 1899, a second hemorrhage appeared which also lasted 24 hours: for the last year slight pains have been present in the left kidney region, to which the patient has paid little attention. Tenesmus and pain on urination never present—urine of normal appearance. Several examinations caused suspicion to be directed to some disease of the spleen: proportion between red and white blood corpuscles normal. Kocher (Bern) found leucocytes and casts in the urine: albuminuria.

19. July. *Exposure of the left kidney.* It seemed to Kocher on palpating the right kidney during the operation, that it was not normal, and so he closed the wound without having operated on the left kidney.

29. IX. '99. Patient came under our observation. Slight albuminuria.

30. IX. '99. Three casts (1 hyaline and 2 granular). Urine looks normal, albumen not perceptible, Spec. Gr. 1020, one red blood corpuscle, several leucocytes. Cystoscopic examination:—Bladder normal, left ureter crater-like, contracts, discharges no fluid, right ureter slit-like, discharges urine.

1. X. Microscopical finding—occasional red blood cells and leucocytes.

2. X. Ureteral catheterization right and left: *catheter pushed up to the renal pelvis on the left, discharges not a single drop*, even after injections: on the right, abundant clear urine, epithelium, considerable number leucocytes, isolated red cells, trace of albumen.

3. X. General condition good.

4. X. In spite of abundant diuresis (2 bottles Faschinger) the left ureter secretes no urine (10 m. observation).

5. X. Catheterization of left ureter (10 m.) produced no urine.

6. X. Metabolism: Patient received 2 liters milk, $\frac{3}{4}$ lb. shaved meat, 3 milk biscuit; freezing point of ureter urine

—2°, freezing point of the urine from the bladder (passed 2 hours earlier) —1.01°, chlorine from ureter, 1.0764 per cent., chlorine from bladder urine 0.889 per cent.; N from ureter urine 0.469 per cent., N from bladder urine 0.595 per cent. From the 5th to the 6th of October N ingestion was 17.135 gm. N, N excretion was 21.07 gm. N. In the blood $\delta = -0.56^\circ$, NaCl of blood 0.52 gm.

7. X. Catheterization of both ureters repeated—the left secretes no urine, Spec. Gr. 1019 on the right.

9. X. Discharged.

Patient returned to the surgical clinic of Professor Kocher in Bern for treatment, where he died of œdema of the glottis eight days after the operation (nephrectomy). Professor Kocher's report is as follows:

H. T. died suddenly from œdema of the glottis, although ten minutes previously he had been talking with the attendant. He had a laryngitis: the disturbed kidney function probably had its influence on the fatal result. The death is certainly less to be regretted since very numerous metastases were present. *Otherwise the result of the investigation of the renal function proved correct.* For during the first 8 days when H. T. was in very good condition, the secretion of urine was very abundant, and the autopsy showed *simply old infarcts in the right kidney.*

Gez. Kocher.

No. 21. D. (Woman.) [Policlinic.] *Prolapse of Urethra.*
U. C. (Ureteral Catheterization).

	R.	L.
Amt.	28 c.c.	22 c.c.
Sugar ¹	0.9%	0.8%
N	0.399%	0.445%

Urine of left side very bloody on account of trauma. Probably this explains the slight increase of N.

¹ Unless otherwise stated the sugar percentages in the following cases are due to the phloridzin.

No. 22. P. *Chronic Urethritis*. (Policlinic) U. C.

	R.	L.
Amt.	23 c.c.	21 c.c.
Sugar	1.8%	1.8%
N	0.616%	0.616%

No. 23. N. *No Diagnosis*. Woman who had had fever.

	R.	L.
Amt.	21 c.c.	21 c.c.
Sugar	0.7%	1% ¹
N	0.42%	0.54%

No. 24. Mrs. H. (Klin. Behandlung, 51.) *Convalescent pyelitis, gall-stone colic*.

Five years ago following the birth of a child, patient had pains in the *left side*. *A stone was passed*, and later *four others*. Two weeks ago patient had severe pains which lasted uninterruptedly for fourteen days. *Blood* in urine, desire to urinate, accompanied by pain. Vaginal discharge. Four living children, three dead, five abortions. The attacks recur every 2 to 3 days—during these periods, only about 250 c.c. urine in 24 hours.

26. VII. 1899. Ureteral catheterization. On the left, 9 cm. in the ureter from the bladder is an obstruction.

27. VII. Last evening a very severe attack of pain—2 morphine injections. Patient is said to have passed a great deal of urine. The urine which yesterday was clear is to-day very purulent. This is reported to be the case after every attack of colic.

28. VII. Attack of colic and discharge of pus ceases.

29. VII. Catheterization repeated on two different days, but the obstruction remains at the same height. Later after the confinement, spontaneous passage of a stone, size of a bean.

On the 4th January, 1900, the patient was suddenly taken with severe pains in the region of the gall-bladder, which was

¹ Thus far the only exception.

also tender on pressure. A tumor was felt which was taken for the *gall-bladder*—no jaundice. Pains came in attacks. On the 15th January, a severe peritoneal inflammation which included the whole right half of the abdomen, appeared as a complication. With rest and ice, this subsided after ten days. Meanwhile the urine became still more cloudy, and the pains now radiated down to the bladder. Since the 30th January, the amount of urine has diminished to 500 c.c.; it is very cloudy, acid, sediment of epithelium and white corpuscles, no passage of detritus or stones observed. Now one feels in the right side an uneven moderately movable tumor, which was supposed to be a movable kidney containing calculi.

On inflation of the rectum, the tumor can no longer be felt, the liver on the contrary can be quite clearly mapped out. Urine contains traces of albumen. Ureteral catheterization performed with following results.

	R.	L.
	Almost clear.	Cloudy.
Amt.	25 c.c.	35 c.c.
Δ	—0.59°	—0.69°
Sugar	0.4%	0.4%
N	0.224%	0.35%
	No albumen.	Small amt. pus and albumen.

(Urine very much diluted through large amount water taken.)

The 24-hour amount of urine varied during the patient's stay in the hospital between 900 and 1,600 c.c. Temperature always afebrile. After long continued rest in bed the patient had only little pain, and that in the liver region. *Some weeks later, jaundice and typical gall-stone colics appeared.*

No. 25. H. Friederich. 20 yrs. *Urethritis.*

Gonorrhea 1½ years ago with right epididymitis—now left epididymitis. Urine: First portion cloudy, second portion

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clear. Prostate rather hard and somewhat enlarged on the left
Ureteral catheterization, simultaneous.

	R.	L.
Amt.	35 c.c.	21 c.c.
Sugar	1.6%	1.5%
N	0.490%	0.448%

No. 26. M. 46 yrs. *Right renal calculus.*

(Clinical patient from Hagen.) Married, healthy children, never had venereal disease, has always been well. Two years ago hæmaturia suddenly appeared which continued (although with interruptions) for fourteen days. No symptoms of hemorrhage for a whole year, then again hæmaturia for several days (following over-exertion and taking cold). Six weeks ago a slight hemorrhage. Cystoscopy showed nothing—clotted blood is being passed. In the first portion of urine are flocculi (hæmaturia). Patient examined in an interval free from hemorrhage—simultaneous ureteral catheterization.

	L.	R.
Amt.	68 c.c.	25 c.c.
Sugar	1.4%	0.5%
N	0.63%	0.49%

No. 27. K. 35 yrs. (Klin. Behand., 99.) *Right nephrolithiasis.*

Since June, 1898, patient has complained of attacks of pain in the right kidney region which recur at intervals of weeks (renal colic). During the attacks there is blood in the urine, sweating and vomiting. The attack before the present ones occurred three years ago.

6. III. No symptoms.

7. III. Irrigation of bladder with Arg. nitr. 1-2,000.

11. III. Urine clear. (*Note*, blood-cells have never been found here in the urine.)

13. III. No symptoms.

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14. III. Hemorrhage, which ceased after an hour however.

16. III. R, 100 grm. glycerin. Ureter catheterization—simultaneous.

	L.	R.
Amt.	31 c.c.	25 c.c.
Sugar	2.4%	1.4%
N	1.064%	0.818%

No. 28. Mrs. B., 44 yrs. *Contracted bladder.* (Stolpe a. o. Klin. Beh., 1888.)

Patient is married and has children. Has suffered ever since her sixth year with bladder symptoms, pain on urination and frequent tenesmus. She has been frequently treated elsewhere (with bladder irrigations).

14. II. Bladder irrigation with Arg. nitr. 1-10,000.

15. II. The same.

18. II. Sublimate injection, 1-5,000.

19. II. The same.

20. II. The same.

21. II. Severe pain after the sublimate irrigation. Hot compresses.

22. II. Sublimate irrigation. Slight improvement.

24. II. Sublimate injection 1-4,000. Menses.

Cystoscopy: Contracted bladder—scar in the bladder. U. C. (ureteral catheterization) simultaneous. (Urine considerably diluted.)

	R.	L.
Amt.	36 c.c.	35 c.c.
Δ	—0.50°	—0.50°
Sugar	1.4%	1.4%
N.	0.213%	0.206%

No. 29. von H. 27 yrs., from Charlottenburg. (Klin. Behand., 95.) *Double renal tuberculosis.*

Patient is a gymnast, brother died of phthisis. In 1893 a hemorrhage from the urethra suddenly appeared, which lasted for four weeks. Soon after, the patient acquired gonorrhea

which was complicated by a right epididymitis, and a prostatitis. The abscess of the prostate was operated on, and following the operation which was performed from the rectum, fistulæ formed in the right scrotum. In January, 1900, another hemorrhage suddenly appeared, lasting four weeks. On examining the almost exsanguinated patient with a sound, a stricture was found 10 cm. from the glans: since a portion of the blood comes out of the urethra, and a portion from the fistula, there must be a communication between the latter and the urethra.

24. II. Internal urethrotomy, in order to enable a cystoscopic examination to determine the origin of the hemorrhage. Diet: milk, wine. Enemata of NaCl (1 per cent.) t. i. d.

26. II. Appetite good.

27. II. Hemorrhage ceased.

28. II. Removal of constant-drainage catheter.

1. III. Bougie.

3. III. Bougie.

5. III. Metal Bougie.

6. III. Metal sound 24.

7. III. Bladder irrigated with Arg. nitr. 1-2,000.

8. III. Metal sound.

9. III. Same.

10. III. Same.

17. III. Irrigation.

21. III. Operation on fistula—laid open, curetted. Resection of right epididymis. Packing.

26. III. Dressing changed.

28. III. Dressing changed.

2. IV. Dressing changed—wound healed well.

4. IV. Bougie does not pass.

5. IV. Dressing changed—wound granulating well.

6. IV. Dressing changed.

7. IV. Sound passes.

9. IV. Metal sound passes without difficulty.

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10. IV. Warm sitz-bath with 3 sublimate pastiles (1-10). Wound looks well. Little discharge. Urine still comes out of the fistula. Packing of wound with iodoform gauze.

14. IV. Patient discharged improved—has gained 6 lbs. Results of U. C.

	R.	L.
Amt.	35 c.c.	34 c.c.
Δ	-0.79°	-0.84°
Sugar	0	Traces (less than 0.1%)
N	0.78%	0.91%

Large amount albumen (0.4 per cent.) on both sides. Examined in interval free from hemorrhage.

No. 30. Richard P. 25 yrs. Wood sculptor, (Poliklin. Protocoll, 5420). Patient suffers from seminal emissions. Never had gonorrhea. Sexual power retained. *Diagnosis: Sexual neurasthenia.* U. C.

	R.	L.
1. Amt.	22 c.c.	17 c.c.
NaCl	1.158%	1.158%
N	0.525%	0.55%

2. After .005 grm. phloridzin. U. C.

	R.	L.
Amt.	22 c.c.	20 c.c.
Sugar	2%	2%
N	0.525%	0.538%

No. 31. The same patient as No. 30. Urine greatly diluted by drinking mineral water. U. C. (phloridzin).

	R.	L.
Amt.	50 c.c.	35 c.c.
Sugar	0.2%	0.2%
N	0.202%	0.214%

No. 32. Mrs. W. 35 yrs. *Left pyonephrosis.* (Poliklin. Protocoll, 5588.)

For the last year pains in the left side—no tenesmus. Confined four months ago. Twice has had still-born child. For

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four weeks pains have been continuous—slight pyuria. Syphilis. Ureteral catheterization shows left pyelitis.

24. I. Irrigation left kidney pelvis with Arg. nitr. 1-1,000.

26. I. Irrigation bladder with sublimate 1-10,000. Urine much clearer, but still opaque.

27. I. Irrigation left kidney pelvis. Urine noticeably clearer.

29. I. Irrigation left kidney pelvis.

31. I. Irrigation bladder with Arg. nitr. 1-1,000. Urine almost clear.

12. II. Irrigation bladder with Arg. nitr. 1-1,000.

15. III. Irrigation left kidney pelvis 1-1,000. Pains in kidney region. Urine cloudy.

I. IV. Bladder washed out. U. C. (phloridzin).

	R.	L.
Amt.	26 c.c.	23 c.c.
Sugar	1.5%	0.7%
N	0.287%	0.17%

No. 33. H. B. 30 yrs. Salesman. (Poliklin. Protocoll, 5253.) *Right renal calculus.*

Always well previously. On Sept. 9, 1897, the patient entered the hospital in a nervous condition with a calculus impacted in the urethra. Urethrotomy, removal of the stone which consisted of oxalates. In the summer of 1898 symptoms reappeared. Catarrh of the bladder.

15. XI. Bleeding from the urethra, pains in the region of the symphysis, sediment in the urine, sticking pain in the glans at the end of micturition.

11. XII. On the 10th at 9 in the evening a more severe attack of pain in the right lumbar region—vomiting until 2 o'clock in the morning. Ureteral catheterization. The catheter meets an obstruction in the right ureter after having been introduced 14 cm. Urine flows by it out of the catheter however. The free end of the ureter catheter is 36.5 cm. from the cysto-

scope funnel. Microscope: shows white and red blood corpuscles in the bladder urine. The urine from the ureter catheter is slightly bloody.

13. XII. Yesterday pains on the right were not as severe, and of a drawing character, radiating from the kidney region to the groin.

13. XII. No pain. Slight cloudiness in bladder urine due to round cells. No red blood corpuscles discoverable. Ureter-cystoscopy:—Obstruction in the right ureter when the end of the catheter is 40.5 cm. from the funnel of the cystoscope. The ureter catheter can be pushed forward 10 cm. with great difficulty.

19. I. X-ray photograph (taken two weeks previous) shows a mass in the right kidney region about the size of a quarter which interrupts the Roentgen rays. A second plate taken later on was not positive, and shows nothing. U. C. (phloridzin).

	R.	L.
Amt.	18 c.c. (some albumen)	38 c.c.
Sugar	1%	1.4%
N	0.515%	0.707%

Patient was operated on by Professor Israel. The operation (right nephrotomy) passed off smoothly without remarkable incidents. On the evening of the third day, the patient died from cardiac paralysis. The result of the autopsy most kindly furnished us by the operator is as follows:

"Death due to a high-grade myocarditis of long standing. Heart flabby, muscle very pale, left ventricle dilated, trabeculae carneae flattened, in the myocardium stripe-shaped petechiae and yellow discolorations. Right ventricle very much dilated, wall thinned down to 2 mm., under the endocardium points and stripes of yellow deposit. Coronary arteries sclerotic and much narrowed. The myocardium contains numerous gray foci so that the heart muscle has a spotted appearance.

Left kidney large—smooth surface. Kidney pelvis dilated—mucous membrane white, thickened, papillae greatly flattened

so that the kidney pelvis and calices make a single cavity containing about 30 c.c. Narrow cortex of normal topography without inflammatory changes. Left ureter greatly dilated, mucous membrane pale—5 cm. Above the bladder there is an ampulla-like dilatation.

Right kidney (operated on) somewhat more hydronephrotic than the left. Contents of kidney pelvis sanguinolent.

Amount of urine on day of death 560 c.c. Spec. Gr. 1026.

No. 34. Mrs. A. J. (Polikl. 5548.) *Right pyonephrosis. Left nephritis.*

10. I. Pains in both lumbar regions following exposure to cold 3 to 4 years ago. At times urine is very cloudy—increased desire to micturate (four times during the night), persistent pain in *right* lumbar region. Has never passed blood in the urine. No pain on micturition. Urine very cloudy, purulent, alkaline reaction. Amount of albumen corresponds to the amount of pus. No sugar. Sediment: pus and numerous bacteria. Cystoscopy: high grade of reddening, relaxation and flecking of bladder mucous membrane. Diffuse cystitis. Right kidney enlarged, palpable, and noticeably hard.

24. I. Ureteral catheterization. Urine from the left ureter contains albumen (after filtration, a clearly apparent ring about 2 mm. broad on nitric acid test). In centrifuged sediment large number red corpuscles, white round cells, more than would correspond to the number of red cells, and a large amount of caudate epithelium. On the right side less albumen, still an appreciable amount, numerous white round cells and epithelium. Left kidney enlarged—palpable.

5. IV. Irrigation of the right kidney pelvis with Arg. nitr. 1-1,000 done twice at intervals of eight days without result. U. C. (phloridzin).

	R.	L.
Amt.	30 c.c.	31 c.c. (purulent)
Sugar	0.15%	0
N	0.35%	0.25%

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No. 35. K. 35 yrs. *Right nephrolithiasis*. (Poliklin. Protocoll, 5673; cf. Poliklin. Prot., 5282.)

Patient has complained of attacks of pain in the right kidney region since June, 1898 (renal colic). Blood and pus in the urine during attacks, the last one three days ago. Attacks accompanied by sweating and vomiting. U. C. (phloridzin).

	R.	L.
Amt.	55 c.c.	38 c.c.
Δ	-0.25°	-0.20°
Sugar	1.2%	0.6%
N	0.175%	0.105%

No. 36. August P. 27 yrs., unmarried. (Poliklin. Protocoll, 5649.) *Chronic nephritis*.

Four years ago was under treatment for acute nephritis in the Charité Hospital for 13 weeks, and discharged unrecovered. Patient at present complains of exhaustion, frequent desire to urinate with passage of little urine each time. Now oedema of lower limbs and face has reappeared. U. C. (phloridzin).

	R.	L.
Amt.	15 c.c.	25 c.c.
Δ	-0.99°	-1.16°
N	0.756%	0.81%
Sugar	less than 0.1%	Slight traces.

Albumen on both sides, more on the right than on the left. Beginning of sugar reaction also much later on the right than on the left.

No. 37. R., Bertha, 48 yrs. Married. (Poliklin. Protocoll, 5792.) *Hysteria* (stigmata).

For three years pain in sacrum, desire to urinate. Urine comes away very slowly, accompanied by pains in the left side of the abdomen. For the last six months, the pains, which have a stabbing burning character, have radiated over on to the

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right side. Urine often cloudy. As a left renal disease was suspected another physician catheterized the woman's left ureter, and allowed the catheter to remain in position 24 hours. Negative finding. Increased patellar reflex, corneal reflex slightly diminished. Pharyngeal reflexes absent, globus very seldom, no disturbance of sensibility. First and second portions of urine clear, sediment shows nothing pathological. Cystoscopic examination negative. U. C. (phloridzin).

	L.	R.
Amt.	30 c.c.	29 c.c.
Sugar	0.8%	0.9%
Δ	— 0.74°	— 0.81°
N	0.357%	0.413%

No. 38. L. (*No diagnosis.*) 27 yrs. Kl. Pr., 104.

One year and a half ago patient had blood in the urine for the first time (Oct., 1898). The hemorrhage continued for months and came twice daily with the urine. Then came a pause of 8 months, until January, 1900, when the hemorrhage reappeared, and was found to come from the right kidney: it lasted but a few days however. Bronchial breathing in left pulmonary apex. Urine 1800 c.c., Spec. Gr. 1020. Father died of phthisis.

19. III. Meatotomy.

20. III. Ureteral catheterization: no albumen from either side—wholly normal; red blood corpuscles found in examining urine. Tuberculin injected as renal tuberculosis was suspected. A reaction followed on one occasion, no reaction on another. Examination of the genitals gives no clue to a tubercular disease. Accordingly ureteral catheterization with phloridzin injection.

	L.	R.
Amt.	38 c.c.	28 c.c.
Δ	— 1.21°	— 1.33°
N	0.567%	0.609%
Sugar	2.8%	2.4%

No. 39. Emil St. 23 yrs. Unmarried. (Poliklin. Protocoll, 4704.) *Hæmaturia, pyelitis, gonorrheal cystitis.*

Always well up to a few weeks ago—never had venereal disease. Last coitus three months ago. Ten days ago frequent desire to urinate appeared (every ten minutes). At times urination accompanied by pain, at times it required some time for the urine to come. Tenesmus improved by medicine. Patient noticed blood in his urine for the first time, three days ago.

Now passes water every two hours. Last night was not obliged to urinate at all; the night before, once. Parents healthy. No cough, good appetite. Constipated. Urine bloody.

Cystoscopy: Severe cystitis, so one cannot see fluid come from the ureters. Suspicion of pyelitis.

30. I. Ureteral catheterization shows cloudy urine on both sides.

15. II. Irrigation of right kidney pelvis with hydrarg. oxycyan.

22. II. Urine very purulent. Irrigation of bladder with Arg. nitr. (1-1,000).

1. III. Bladder washed with Arg. nitr. 1-1,000. Infiltration of apex of lung and roughened vesicular breathing.

Patient has fully recovered from his pyelitis through several irrigations of the kidney pelvis with Arg. nitr. The process in the apex of the lung is also healed. U. C. (phloridzin).

	L.	R.
Amt.	31 c.c.	40 c.c.
Sugar	1 %	1 %
Δ	—1.06°	—1.06°
N	0.42 %	0.42 %

27. IV. 1900.

No. 40. Frieda Z., 17 yrs. (Poliklin. Protocoll, 5782.) *Hemorrhagic nephritis.*

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Urine has been dark brown since the end of last year. Face œdematous. Pains now and again in the sacrum. No tenesmus—large amount albumen. Epithelial casts.

Ureteral catheterization (phloridzin). Urine on the left very bloody—on the right very slightly so. Large amount albumen, hyaline, epithelial, and blood casts on both sides.

	L.	R.
Amt.	42 c.c.	32 c.c.
Δ	—0.29°	—0.39°
Sugar	0.5%	1.0%
N	0.338%	0.35%
	Very bloody. Slightly bloody.	

No. 41. Mrs. H. (Poliklin. Protocoll, 5781.) 25, V., 1900.
Neurosis of the bladder.

For the last year urinary symptoms of various sorts day and night. No blood ever noticed in the urine.

Pain in the abdomen, right and left sides. The right kidney somewhat prolapsed. Nothing abnormal palpable. General condition of patient excellent.

U. C. (phloridzin). Urine collected in the second hour after Ph. injection.

	L.	R.
Amt.	38 c.c.	31 c.c.
Δ	—0.89°	—1.00°
Sugar	0.8%	0.9%
N	0.266%	0.294%

No. 42. Mrs. Gr. (Poliklin. Protocoll, 5846.) *Tumor right kidney. Hæmaturia left kidney* (cause unknown).

Blood in the urine for last five weeks, pain almost never present. Patient is very much run down. An ovarian tumor is present which was first noticed some years ago. The blood comes from the left kidney. At a second examination clear urine free from albumen was obtained from the left ureter, and from the right, at first none, then after withdrawal of the

catheter, cloudy albuminous urine. Sugar reaction after Ph. injection *positive on the left—negative on the right*.

(Report of the gynæcologist who previously examined patient.)

26. IV. 1900. Cystoscopy showed urine containing much blood from the left ureter; from the right ureter, collected by catheter, totally clear urine which contained a slight trace of albumen.

30. IV. Urine continues cloudy and bloody, also when patient is examined. Cystoscopy shows that both ureters appear to functionate amply, and that both discharge apparently clear urine. Ureteral catheterization proves that the urine from the left ureter is somewhat tinged with red. The cloudiness is due to blood corpuscles. This urine contains phosphates and a trace of albumen. The urine from the right ureter (collected by catheter) is perfectly normal.

Our ureter-catheter examination following phl. injection showed

L.	R.
Positive reaction after 20 m.	Permanently negative.
Clear—no albumen.	Cloudy, albumen, leucocytes.

The hemorrhage of three weeks' duration came from the left kidney. U. C. (phloridzin).

	R.	L.
Amt.	32 c.c.	95 c.c.
Sugar	0	0.2% ¹
Δ	—0.79°	—0.52° ¹
Microscop. leucocytes.		
N	0.49%	0.35% ¹

No. 43. (Woman.) 3. VII. 1900. *Tumor right kidney.*

The same case as No. 42, examined 2 months later. No hemorrhage now. Excellent general condition. U. C. (phloridzin).

¹Figures very low in consequence of the greatly diluted urine.

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	R.	L.
Amt.	31 c.c.	33 c.c.
Sugar	0	0.2%
Δ	-0.95°	-1.7°
N	0.65%	0.77%
	Slight amt. albumen.	No albumen Sugar reaction after 25 m.

No. 44. Mrs. B., married, 64 yrs. (Poliklin. Protocoll, 5865.) *Cystitis. Left pyelitis.*

8. VI. 1900. Ureteral catheterization (phloridzin).

	R.	L.
	Slightly cloudy.	Cloudy.
	Epithelium.	Pus.
	Moderate amt. albumen.	Slight amt. albumen.
Amt.	14 c.c.	15 c.c.
Sugar-reaction after 25 m.		Reaction after 54 m.
Sugar	0.1%	0.1%
N	1.14% (fever)	1.14% (fever).

No. 45. Kn., Gustav. *Left nephrolithiasis.*

36 yrs.—married. (Poliklin. Protocoll, 592.) Beginning of February, severe pains appeared in left side. On March 16 sudden retention of urine, relieved by catheterization. Large amount of albumen discovered the same day in the urine. No venereal disease. Never had blood in urine.

26. VI. 1900. U. C. (Phl.)

	L. Pus.	R. No sediment.
Amt.	26 c.c.	24 c.c.
Δ	-1.08°	-1.55°
Sugar	0.3%	0.5%
N	0.56%	0.86%

No. 46. Elias R., 24 yrs. Unmarried. (Poliklin. Protocoll, 3637.) *Pyelonephritis.*

Since February 1, 1897, patient has had pain in the central portion of his urethra after micturition (infection denied). Urethral discharge. Treated with 2 per cent. arg. nitr. and Guyon catheter. At that time urine was cloudy with flocculi. After treatment there was blood at the end of urination also. For the last three weeks the pain has been principally in the glans. At first patient had desire to pass water every hour, at night twice; now every two to three hours, and once at night. Discharge less (watery). Urine contains numerous leucocytes, and much albumen.

3. III. 98. Patient complains of pain at the end of micturition, and of more frequent desire to urinate when he drinks much beer.

Urine in both I. and II. portions rather cloudy, with flocculi—large amount of albumen in filtered urine ($1\frac{1}{2}$ per cent.).

Microscopically: Hyaline casts, leucocytes. U. C. (phl.).

	R.	L.
Amt.	40 c.c.	36 c.c.
Δ	—1.12°	—1.10°
Sugar	1.4%	1.3%
N	0.427%	0.483%
	Albumen,	Albumen,
	pus.	pus.

No. 47. Gertrude P., 27 yrs., married. (Klinik, 117.) 4.
V. 99. *Vesical calculus.*

Cystitis four years ago, which was treated by irrigations. Last June the pains recommenced in the bladder region. Desire to pass water comes principally after the mid-day meal, less often at night. During the last four months the patient has noticed she has passed stones, and for the last four weeks has had pains in the left kidney region radiating to the left groin, and coming in attacks. Urine clear. Cystoscopic examination showed an uneven stone of white color (calcium carbonate and oxalate, as was determined after removal). Urine clear. Slight inflammatory change at neck of bladder.

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5. V. Patient has pain on micturition, and on lying on her back she suffers more pain than in walking or standing. Ureteral catheterization (phloridzin).

	R.	L.
Amt.	38 c.c.	42 c.c.
	(very much diluted)	
Δ	— 0.22°	— 0.22°
Sugar	0.4%	0.4%
N	0.98%	0.98%

No. 48. Wilhelm B., 38 yrs., married. Master-baker. (Klin. Prot., 127.) *Left pyelonephritis.*

II. VI. For the last year the patient's urine has been cloudy from pus. Otherwise the man is perfectly well. Has already been medically treated with silver nitrate bladder irrigations. Gonorrhea twice, the last time in 1899. Nothing pathological in the lungs. After treatment with sublimate 1 : 5,000 and arg. nitr. 1-1,000, the cloudiness of the urine diminished somewhat, but reappeared after a time. No subjective symptoms. No increase in desire to micturate. At night the urine can be held for hours at a time.

12. VI. Constant-drainage catheter inserted. Irrigation of bladder with arg. nitr. 1 : 1,000, and every three hours with hydrarg. oxycyan. 1 : 10,000.

13. VI. Irrigation of bladder with arg. nitr. 1-1,000, and every three hours with hydrarg. oxycyan. 1-10,000.

14. VI. Irrigations with arg. nitr. of hydrarg. oxycyan. discontinued.

15. VI. Urine cloudy, albumen in proportion to amount of pus—in sediment principally pus corpuscles. Ureteral catheterization after phloridzin; left side cloudy, reaction protracted, coming after 43 min. and very weak; in the right side catheterization could not be done. The urine collected from the bladder—reaction appeared after 35 min.

17. VI. Irrigation bladder with arg. nitr. 1-1,000, urine cloudy at times.

18. VI. Irrigation bladder with arg. nitr. 1-1,000, three tablets urotropin (each 0.5) daily.

19. VI. Constant-drainage catheter, idem.

20. VI. Urine less cloudy, idem.

22. VI. Same treatment continued—patient discharged from the clinic. U. C. (Phl.).

R. Catheter in the Bladder.		L. Catheter in Ureter.	
Sugar after 35 min.		Sugar after 43 min.	
Slight trace albumen.		Moderate amt. albumen, pus.	
Sugar	1.2%		0.6%
N	0.403%		0.315%
Δ	-0.78°		-0.59°

No. 49. Mrs. W. (Case of Professor *Litten*.) 2. III. 1900.

A tumor is said to have been felt on the right—now not palpable. Woman is in a miserable cachectic condition. No diagnosis made. U. C. (Phl.)

	L.	R.
Amt.	40 c.c.	25 c.c.
Δ	-0.35°	-0.31°
N	0.21%	0.21%
Sugar	1%	0.8%

No. 50. Mrs. H. 3. V. 1900. (Cf. case 41.) *Neurosis vesicae*. U. C. (Phl.)

	R.	L.
Amt.	35 c.c.	42 c.c.
Δ	-0.78°	-0.67°
N	0.252%	0.202%
Sugar	0.7%	0.15-0.2% ¹

No. 51. U. 20. V. (Case of Professor *Rotter*.) *Right renal tuberculosis*.

¹ Probably a mistake, as this is the only case with such a discrepancy for which no reason can be assigned.

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Suppuration of the right kidney with nephrotomy many years ago. Since then a permanent fistula of the right kidney. Ureteral catheterization. (Phl.)

R.		L.	
(Bladder urine, catheter was in the bladder.)		Amt.	12 c.c.
		Δ	-0.61°
Amt.	44 c.c.	Sugar ...	0
Δ	-0.83°	Albumen, considerable amt.	
Sugar	0		
Albumen, moderate amt.		Very many leucocytes (also	
Microscopically: Moderate amt.		in form of casts) uric acid,	
leucocytes, occasional epithelial casts.		calcium oxalate.	
		N	0.602%
N	0.105%	Casts, granular, epithelial and hyaline.	
(Apparently diluted with wash-water which had been left behind.)			

No. 52. Willy B., 22 yrs. (Department official, KI., 119.)
Right pyelonephritis.

February, 1899, gonorrhea; March, phimosis operation; April, cystitis; in February, 1900, inflammation of kidney pelvis, patient in a Berlin hospital from 10th March to 3d May. Albumen in urine, red and white blood corpuscles in sediment.

8. V. First portion urine cloudy, second less cloudy. Arg. nitr.; irrigation.

9. V. First and second portion urine cloudy.

10. V. Urine cloudy, mustard plaster to back.

11. V. Arg. nitr. irrigation (1:1,000).

12. V. Same.

14. V. Sound No. 18. Urine first and second portion clearer.

18. V. Arg. nitr. irrigation (1-1,000).

19. V. Cystoscopy: Shows injection of vesical mucous membrane which is covered with purulent flecks.

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20. V. Sound No. 18. First portion urine rather cloudy, second portion clearer.

22. V. Urine clear. Patient complains of pain in the right kidney region.

25. V. First and second portions clear. Irrigation with arg. nitr. (1-1,000).

26. V. Irrigation bladder with arg. nitr. 1-1,000. Patient leaves the clinic. U. C. (Phl.)

	R.	L.
Amt.	35 c.c.	29 c.c.
Sugar	+ in 21 min.	+ in 21 min.
Δ	-1.10°	-1.26°
Sugar	2%	2.8%
N	0.455%	0.556%
	Albumen, leucocytes.	No albumen.

No. 53. Willy B., 22 yrs. 29. VI. 1900. (Cf. case 52.)
Right pyelonephritis. U. C. (Phl.)

	R.	L.
Amt.	38 c.c.	1.29 c.c.
Sugar	+ in 33 min.	+ in 18 min.
Sugar	0.8%	2%
Δ	-1.08°	-1.28°
N	0.45%	0.544%
	Albumen in sediment, leucocytes.	Only red cells (trauma), no albumen after filtration.

No. 54. Mrs. K. (Case of Dr. Kümmel, Hamburg.) 64 yrs. *Right renal tuberculosis.*

Always well previously. Three healthy children. For last year and a half trouble in urination. Six months ago, pain in the left kidney region—bloody urine off and on, often sediment. Blood (δ) = -0.56°, Δ , right = -1.51°, left = -0.7°.

Phloridzin; right side positive in 30 min.; left remains negative (examined 65 min. after injection).

Operation: 18. VI. Nephrectomy of left kidney, which was found to be *tuberculous*. Abscesses. Condition of patient gratifying (recovery).

No. 55. Mrs. P. (Case of Dr. K $\ddot{u}$ mmel, Hamburg.) 44
yrs. *Right pyelonephritis with calculi.*

In 1895 patient apparently had bladder-cramp, in 1897 a calculus was passed. For the last six months, dull pain in the right side, and also on urination. U. C. (Phl.)

δ (blood) = -0.56° . Δ , right = -0.14° , left = -1.03° , phloridzin: right, negative; left, positive in 35 min.

Right, U ... 0.57% Left U ... 13.7% (!)

17. V. Operation. Nephrectomy. Right pyonephrosis with calculi. Recovery.

No. 56. Anna F. (Case of Dr. Kümmel, Hamburg.) 18 yrs. *No diagnosis given.*

Previously well—for the last few days pains in the left side coming in colic-like attacks with high temperature.

Blood $\delta = -0.56^\circ$, Δ , right $= -0.42^\circ$; left $= -0.55^\circ$.

Phloridzin positive in 15 min. on both sides. No kidney disease.

+	R.	L.
U	0.654%	0.661%
Sugar	0.38%	0.48%

No. 57. Minna H. (Case of Dr. *Kümmel*, Hamburg.) 20
yrs. *Lithiasis* (?)

During the last three years attacks of pain in the right kidney region; it is stated that there never has been blood or sediment in the urine. Albumen and bacteria in the urine. Pressure on the right kidney causes pain.

Blood $\delta = -0.56^\circ$, Δ right $= -1.50^\circ$, left $= -1.39^\circ$.

Phloridzin positive in 18 min. on both sides.

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	R.	L.
Sugar	1.515%	1.19%
+		
U	1.079%	1.050%

No. 58. Wladimir L. *Right nephrolithiasis.*

Patient was taken ill in 1880 with pains in the right side, when a stone was passed for the first time. Since that time six to eight stones have come away. Last July frequently recurring chills appeared. At that time much gravel was passed, and patient was confined to his bed for several weeks. In July of this year he was in Carlsbad, and from there was sent here by Geheimrath *Jacques Meyer* for treatment. The present symptoms consist of pains in the right side, especially on moving about. The patient declares he can tell every time a concrement passes into the bladder. (Among previous diseases, the patient had syphilis in 1880.)

21. VII. Cystoscopy: Slight cystitis. Right ureteral opening large, dilated. Bladder urine cloudy, contains pus and red corpuscles. Albumen in proportion to the amount of pus.

22. VII. Ureter cystoscopy: Left—positive reaction in 35 min. On the right the ureter catheter meets an obstruction a short distance from the bladder ureteral opening—reaction negative. The right catheter lay in the bladder. Morphium 0.01. The urine collected from the bladder continues to show no reaction; but as soon as the catheter is removed from the left ureter, the reaction appears in the bladder urine; showing the right ureter catheter is wholly obstructed. At evening a chill—temperature up to 40.1°, quick drop to normal after 1.0 grm. quinine.

23. VII. No fever. Complaint of pain in the right side of the bladder. Tenesmus suddenly appeared, with sticking pain in the end of the penis.

24. VII. Another chill this morning at 6.30; temperature, 40.1°. Quinine, grm. 1.0. Temperature normal again at noon. The same symptoms as yesterday. In the urinary sediment

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white and red cells, traces of albumen. Patient obliged to pass water every hour during the night.

25. VII. No fever, less pain, general condition better. Patient sleeps quietly at night.

26. VII. 24 hr. amount of urine 1,470 c.c., Spec. Gr. 1010, traces of albumen, alkaline reaction, no albumen, no fever. Patient was out of bed, but still feels exhausted. U. C. (Phl.)

	R.	L.
Amt.	26 c.c.	40 c.c.
Δ	— 0.54°	— 1.48°
Sugar	0	1.6%
N	0.38%	0.764%
	Urine from the bladder.	Urine from the ureter.

On the right side, albumen, pus, red cells. The catheter passes into the ureter for only a few centimeters, and then meets a noticeable hindrance.

No. 59. Mathilde St., Cab-driver's wife, 37 yrs. *Renal syphilis*. Syphilis of long standing.

Patient has had disturbances of vision since June, 1899. A renal affection was diagnosed from the results of the eye-examination. Besides this the woman is reported to have suffered from gall-stone colics. She has had three abortions. Leucoderma. Pulse of hard tension. Aortic tone faint with slight murmur. Urine cloudy, contains pus and a slight amount of albumen. Treatment with iodides. Ureteral catheterization. (Phl.)

	R.	L.
Amt.	30 c.c.	25 c.c.
Δ	— 0.91°	— 1.0°
Sugar	0.4%	0.45%
N	0.504%	0.532%
	Albumen, no casts.	Albumen, no casts.
	Phl. reaction in 25 min.	Phl. reaction in 25 min.

No. 60. Mrs. Dy. (Polikl.) *Right pyonephrosis. Left amyloid kidney.*

Patient had a large tumor on the right side three to five years ago. Myomectomy. She now has pain on the right side. At times urine is purulent, at times clear, and occasionally there is retention. U. C. (Injection of one syringe of phloridzin.) Both sides showed a negative reaction during the whole time. Urine cloudy on the right, clear on the left side. Less urine from the right than from the left.

L.	R.
Enormous amt. albumen	Large amt. albumen

No. 61. Mrs. Dy. (Cf. case 60.) *Right pyonephrosis. Left amyloid kidney.*

7. IX. 1900. Examined three months later. U. C. (Phl.)

	R. ¹	L. ²
Amt.	38 c.c.	24 c.c.
Δ	—0.57°	—0.57°
N	0.175%	0.28%
Sugar	0	0

No. 62. Mrs. F. (Case of Geh. Rath König.) 49 yrs. (Entered 2, IV., 1900; discharged 27, VI., 1900.) *Abscess right kidney, with slight pyelonephritis (right).*

Patient says she has suffered for a long time from a moderate cough, and that she gets out of breath easily. Twenty years ago a normal confinement. As a young girl she had a vaginal discharge, but otherwise has always been well.

The present illness began suddenly 2½ weeks ago with bladder symptoms (cloudy urine, increased and painful desire to urinate). A week later the pains passed over into the lumbar region, and were accompanied by fever, chills and re-

¹ Slightly cloudy from pus, albumen.

² Clear without morphological elements. No albumen (!)

peated vomiting. There are said to have been some bloody shreds in the cloudy urine.

Results of the examination: Frail woman, sallow appearance, very much run down, with an expression of suffering in her face; she makes no complaint and gives the impression of being somewhat demented. Over the *lungs* is pronounced emphysema with many bronchial râles. Slight dulness over the left apex. *Heart* dulness greatly diminished owing to the overlying lungs, tones clear. Liver dulness within normal limits. Abdomen sunken in, abdominal wall generally very rigid on attempting palpation. In the right side of the belly between the lower thorax aperture and the concavity of the ilium and in the anterior axillary line, is a hard tumor the size and shape of a kidney. It has an apparently rather irregular surface, is moderately movable on breathing and palpation, only slightly tender to pressure, and covered by intestine. Left kidney not palpable. At this time no tenderness to pressure in this region can be made out. Temperature 39.7°. *Urine* discharged without pain at normal intervals, very cloudy, contains abundant sediment, in which are to be found masses of leucocytes, much flat and caudate epithelium, salts, and very occasional casts. No pieces of tumor, no concretions, no blood. Albumen 4/10 per cent., Spec. Gr. 1010. Repeated examinations for tubercle bacilli proved negative.

Treatment—kidney diet. Wildunger water.

9. IV. Temperature has fallen to 37.5°–37.9°.

10. IV. 1. Ureteral catheterization: Urine clear on the left side, slightly cloudy on the right. Microscopically: Normal conditions on the left, occasional leucocytes and epithelium on the right.

Treatment: Irrigation bladder with arg. nitr. solutions.

13. IV. Left metastatic parotitis with severe swelling and reddening of the neighboring tissue. Rise in temperature.

17. IV. Right parotid also inflamed, high remittent fever.

27. IV. 2. Catheterization. Findings the same on both

sides: urine clear, with hardly appreciable cloudiness from albumen, occasional leucocytes and epithelium. Functional power left and right equal, and diminished.

I. V. Temperature ranges between 38.5 and 40, very irregular. No chills. The rather dull-minded patient makes no subjective complaints. Dry tongue, poor appetite, condition unchanged.

It has been assumed that there is a right pyelonephritis with abscess formation, and in addition cystitis and a slight affection of the left kidney.

25. V. Nephrectomy (right). Typical König kidney-incision, with the patient lying on her side, in deep morphium-chloroform narcosis. After freeing the kidney, it proved to be of approximately normal size and consistency. At the lower pole where it was difficult to free, *was exposed an abscess in the cortex, the size of a hazel nut*. An exploratory incision showed no gross microscopical changes, nevertheless an extirpation was decided on, from the supposition that the abscess was not solitary, and in order to shorten the operation on the very cachectic patient. The apparently normal ureter tied off with cat-gut, the renal vessels secured with cat-gut ties, at first in toto, and then separately.

The excised kidney revealed *two abscesses the size of beans*, otherwise no gross macroscopic changes visible. Kidney pelvis apparently normal.

26. V. Temperature normal, patient feels well. Amount urine 500 c.c. Slightly cloudy.

28. V. Urine yesterday 700 c.c., to-day 1,000 c.c., cloudy.

I. VI. Dressing changed, wound aseptic. Packing loosened. Temperature which rose to 38.9° on the 30th, has fallen to 36.8-37.6°. Amount of urine already normal on the third day. Same condition as before operation.

12. VI. Temperature from the 1st to 6th approximately normal, from the 6th to the 12th irregularly elevated. Wound clean. Normal amount of *urine*, which is *now more, now less*

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cloudy and with abundant sediment. Good general condition, better appetite. Patient is recovering slowly, and seems more cheerful.

27. VI. Patient discharged. Wound healed except for a small strip of granulation. No tenderness on pressure in this region. Temperature normal for ten days.

Urine: Reaction acid, no albumen, slightly *cloudy*. In the sediment, still moderate amounts of *leucocytes* and epithelium. Amount normal, passed at normal intervals without pain. Patient has improved somewhat, still she is often in a tearful mood with ideas of persecution.

Patient has made further improvement. Temperature continuously normal. *Urine slightly cloudy*. Spec. Gr. of 1004-1016. Amount varies from 400-1,100 c.c., generally about 800. Acid reaction, trace of albumen, no sugar.

Temperature from 6th April to 25th May (day of operation) intermittent. At times remittent from 40.4°-36.2°. After the operation from 25th to 30th May, intermittent rising fever, from 30th May to 6th June another fever remission, but less than formerly, highest temperature 39°. Then no fever from 13th June to discharge on the 27th June. Amount of urine normal soon after the operation. U. C. (phl.) on 28th April, 1900.

	L.	R.
Amt.	45 c.c.	35 c.c.
Albumen	(traces)	Albumen (traces)
Many leucocytes.		Many leucocytes.
Occasional hyaline cast.		Occasional hyaline cast.
Sugar	0.2%	0.4%
Δ	—0.76°	—0.74°
N	0.49%	0.45%

No. 63. Mr. N. 20½ yrs. *Nephrophthisis (bilateral)*. 17. VI. 1900.

Mr. N. 20½ yrs., has a very pronounced tubercular family history; not only on his father's side, but more especially on

the mother's there have been numerous cases of disease and death from phthisis. Personally, except for children's diseases, he was always well. He has never had syphilis or gonorrhea, and never even had sexual intercourse. In January, 1899, he was taken ill in Heidelberg with fever, cough, and difficulty in breathing; *tubercle bacilli were alleged to have been found on examination of the expectoration.* Still, after the disappearance of the fever, no abnormal physical changes over the lungs were discoverable according to the unanimous opinion of several physicians. It must also be emphasized that at the numerous later examinations of the sputum tubercle bacilli were never again found. In March, 1899, he went to St. Blasien and there gained about 15 lbs. in weight. In May of the same year he went to Axenfels in Switzerland, and here without any provocation a hæmaturia set in which caused him immediately to consult a physician. *His physician discovered tubercle bacilli in the urine, and told him that he had renal tuberculosis.* It was then decided to send him to Egypt for the winter. The attacks of hæmaturia now followed each other, both in Switzerland and Egypt, at intervals of about 4 to 6 weeks; they were never very profuse, and always stopped after rest in bed. There were never pains in the kidney region: however the capacity of the bladder gradually diminished, so that now he can hold his urine about 1 to 1½ hours. Urination is accompanied with pain, and at times with severe tenesmus. The urine was continuously cloudy and contained nearly always tubercle bacilli, and red and white blood corpuscles. The amount of albumen varied between ½-1%. The patient never had fever until April of this year. In Venice, however, where he landed on his return from Egypt, a hectic fever made its appearance following an attack of hæmaturia, which lasted about four weeks. At present he is free from fever. He is greatly emaciated, and has lost almost 30 lbs. since he was at St. Blasien.

17. VI. 1900. U. C. (Phl.)

	Moderate amt. albumen. Pus cells.	(Catheter in the bladder.) Large amt. albumen.
Sugar	+ in 20 min.	+ in 20 min.
Δ	—0.83°	—0.81°
Sugar	0.4%	0.15%
N	0.528%	0.504%

No. 64. Herr Z. (Case of Dr. Karewski.) 23 IV. 1900.
Tumor right kidney.

Several attacks of hæmaturia. The bladder urine free from blood, contains albumen. Tumor palpable in the right kidney region. Ureteral catheterization: on the right at first almost clear urine. After about 5 c.c. of urine had been discharged, suddenly there was a severe hemorrhage, which did not diminish even when the catheter was pushed up to the kidney pelvis. Sediment before the hemorrhage: on the right side numerous red cells, normal and abnormal, some few white cells, epithelium; on the left, clear urine, no albumen, only a few epithelial cells in the sediment. Occasional white cells. U. C. (Phl.)

	R.	L.
Amt.	35 c.c.	31 c.c.
Δ	—0.73°	—0.91°
Sugar	traces.	0.2%
N	0.608% (!)	0.35%

No. 65. Mrs. Dr. K. *Right renal tuberculosis* (Kl. 124).

Mrs. Dr. K., 37 yrs., married when a girl of 18. Menstruation previously and now always regular, every 3 to 4 weeks lasting 5 to 6 days, and without pain. Always well as a girl. After four years, the patient obtained a divorce from her first husband who suffered from chronic rheumatism and chronic gonorrheal urethritis. Soon after her second marriage, six years later, she noticed an increased desire to micturate—she

was obliged to urinate very often, and had *very severe pains in the region of the left ovary*. At that time the diagnosis was: Endometritis and chronic oöphoritis. Treatment produced some relief. In May, 1897, the pains returned, there was again increased desire to urinate, and sediment appeared in the urine. Urinary analysis showed: acid reaction, normal color and odor, no albumen and sugar, no pus. The pains disappeared and did not return until August, 1898, when the patient visited relatives, and bathed in cold water. In doing this she took cold, and the desire to urinate again became very severe and painful. The urine again showed a heavy sediment, and on examination *albumen* and pus. Detailed analysis:

Color	pale yellowish.	In the centrifuged sediment:
Transparency	cloudy.	very few red blood cor-
Odor	normal.	puscles, much pus (leu-
Reaction	acid.	cocytes), many <i>tubercle</i>
Spec. Gr.....	1012.	<i>bacilli</i> in many groups.
Albumen	3/10%.	
Sugar	negative.	
Indican	very little.	

R. Instillations for the bladder of 1 per cent. sublimate (after *Guyon*), and creosotal and ol. jecor. asel. intern. The patient took this treatment from the 7th Sept. to the 10th Dec., 1898, and since she improved, she returned to her home. In the middle of December without apparent cause a hæmaturia appeared which lasted 24 hours, and after a week recurred for 24 hours. Cystoscopy; an ulcerated surface which was taken to be the cause of the hemorrhage was seen on the posterior lateral wall of the bladder. Several internists examined the patient, and could find only minimal changes in the lungs under the left scapula, but tubercle bacilli were not found in the sputum, which was purely catarrhal.

In January, 1899, the patient began to improve, while taking

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regular instillations, creosotal, and rich diet, and gained in weight 28 lbs. The urine showed $\frac{1}{8}$ -1% albumen, but less pus, still occasional tubercle bacilli in all preparations. Later the patient began to have pains in the left kidney region which caused her much suffering. Although now the last urine analysis showed only a very few bacilli in many preparations—only one group in one slide—and although at the last cystoscopic examination no ulcerated areas were found, the pain and burning do not cease, and urination is painful. Urinary analysis shows:

Color	pale yellowish.	
Transparency	cloudy.	{ In centrifuged sediment, few hyaline casts, much pus, few red blood corpuscles, very few tubercle bacilli.
Odor	normal.	
Spec. Gr.	1.019.	
Albumen	$\frac{1}{2}$ %.	
Reaction	acid.	

Weight of patient remains the same. The very painful instillations discontinued.

28. V. We personally made the examination; left kidney region painful on palpation, capacity of the bladder 110 c.c. (with difficulty). Cystoscopic finding: bullous oedema of both ureteral openings. In centrifuged urinary sediment tubercle bacilli.

29. V. Examination of lungs and heart shows normal conditions.

30. V. Sublimate instillation 1-1,000. Patient leaves the clinic. Phloridzin-reaction of the bladder urine positive.

1. VI. R. Creosote in ol. lini as a clysma.

26. VI. Cystoscopic examination: The bullous oedema formerly present in the region of both ureteral openings is no longer to be seen. The bladder is in a decidedly better condition, and holds more fluid than formerly.

28. VI. Ureteral catheterization cannot be performed. Repeated flushings of the bladder with sublimate. Cystoscopy

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shows a good condition of affairs on the left. Ureter opening lies somewhat posteriorly and laterally. Bladder holds 100-120 c.c. Ureteral catheterization gives normal urine on left side. Right opening not to be seen.

11. VII. Ureteral catheterization successful. One catheter lies in the bladder, the other in the left ureter. Tubercle bacilli present.

	R. (Bladder urine).	L.
Amt.	15 c.c.	31 c.c.
Δ	—0.89°	—1.03°
Sugar	{ + in 25 min.	+ in 18 min.
	{ 0.75%	1.2%
N	0.30%	0.376%
	Large amount albumen.	No albumen.

No. 66. Mrs. K. (Cf. case 65.) 16. VII. 1900. *Right renal tuberculosis.*

Catheter in left ureter—right catheter in bladder. Sugar positive on both sides in 25 min.

	R.	L.
	Urine cloudy, little albumen.	Clear, no albumen.
Amt.	39 c.c.	38 c.c.
Δ	—1.10°	—1.25°
Sugar	0.9%	1.2%
N	0.502%	0.502%

No. 67. Sophie R. 24 yrs. Married. (Kruschwitz, Prov. Posen.) *Right pyonephrosis.*

11. VII. Patient has had three children. During each pregnancy trouble with the bladder, pains in the right groin and in the right lower extremity. Urine cloudy, no blood. Now three months advanced in pregnancy. Bladder symptoms are just as severe now as in the 6th month in former pregnancies. Albumen positive (corresponding to the amount of pus), no sugar. Sediment: pus. Spec. Gr. 1016.

12. VII. Albumen in proportion to the amount of pus, only

pus in the sediment. Headaches, general lassitude, oedema of both legs. Phloridzin-reaction positive. Irrigation of bladder with arg. nitr. 1-1,000.

13. VII. 24 hours amount urine 900 c.c.; spec. gr. 1015. In spite of two doses of morph. muriat., the patient has severe colic pains in the right kidney region which kept her from sleeping.

14. VII. Ureteral catheterization: Urine cloudy in right, contains much albumen; microscopically, pus; urine on left clear, no albumen, no sediment. Phloridzin-reaction positive but retarded on right side, positive on left.

15. VII. Patient has less pain. Operation on the right kidney advised, but refused. She leaves the clinic this evening.

13. VII. 1900. Ureteral catheterization (phloridzin).

	R.	L.
Urine cloudy, large amt. albumen, only pus cells and fragments in sediment.		Urine clear, no albumen, no sediment.
Amt.	33 c.c.	25 c.c.
Sugar + in 25 min., only traces		+ in 20 min.
Sugar	0	1.0%
Δ	— 0.48°	1.18°
N	0.322%	0.782%

No. 68. Mrs. J., Anna. 35 yrs. (558). *Right pyonephrosis, left pyelonephritis.*

Following exposure to cold 3 to 4 yrs. ago there was bilateral pain in the lumbar region. At that time the urine was very cloudy, increased desire to urinate, four times at night. Persistent pains in the right lumbar region. Blood has never been passed in the urine, and micturition is painless. Urine very cloudy, purulent, with ammoniacal odor, albumen in proportion to the pus, no sugar. In the sediment; pus-cells and numerous bacteria. Cystoscopy: Severe reddening, relaxation,

and flecking of the bladder mucous membrane; provisional diagnosis: Diffuse cystitis.

22. I. Bladder irrigation with arg. nitr. (1-1,000).

24. I. Ureteral catheterization. The urine from the left ureter contains albumen (after filtration a clearly apparent ring about 2 mm. broad with the funnel test). In the centrifuged sediment, numerous red blood corpuscles and white round cells, also abundant epithelium most of which is caudate. Less albumen on the right side, yet clearly apparent, few red blood corpuscles, numerous white round cells and epithelium. Left kidney enlarged, palpable.

5. IV. Irrigation of right kidney pelvis with arg. nitr. 1-1,000, has been done twice now at intervals of a week, without improvement. U. C. (Phl.)

	R.	L.
Amt.	38 c.c.	21 c.c.
Δ	-0.49°	-0.94°
Sugar	0	0.4%
N	0.196%	0.474%
Blood δ - 0.58°		—

No. 69. Mrs. J. (Cf. case 68.) *Right pyonephrosis. Left pyelonephritis.*

Ureteral catheterization of both sides. Right—urine thick and purulent so that the catheter is obstructed. Albumen in proportion to the amount of pus. U. C. (Phl.)

	R.	L.
Amt.	52 c.c.	52 c.c.
Δ	-0.51°	-0.74°
Sugar	0	0.1%
N	0.472%	0.7%

No. 70. Herr. S. (Priv. Prot.) *Left pyonephrosis with calculi.*

Occasional attacks of severe pains on left side.
Purulent urine. U. C. (Phl.)

	R.	L.
Amt.	14 c.c.	13 c.c.
Δ	-0.47°	-0.40°
Sugar	0.4%	0
	Large amount urates.	Leucocytes.
N	0.35%	0.23%

No. 71. R., Herm. 31 yrs. 17. IX. 1900. *Simple chronic urethritis.*

Phloridzin-injection (about 0.008). Bladder urine positive at 1.20 p. m., remains positive till 2.25 p. m. U. C. (Phl.) Rather more flowed from the right than the left, as the left catheter was thinner. (Collected 1½-2 hours after the phloridzin-injection.)

	R.	L.
Amt.	21 c.c.	14 c.c.
N	0.668%	0.762%
Sugar	0.9%	1.0%

No. 72. Mrs. J. 18. IV. '98. *Renal albuminuria. Nephritis (?)*.

Patient is married, and at the last confinement catheterization was necessary from which she got a cystitis. Since that time urine has been cloudy. Cystoscopy: Bladder slightly injected, but no real cystitic changes. No tenesmus, no tubercle bacilli found in the urine.

Ureteral catheterization (phl.). Urine very much diluted as the patient had drunk an enormous amount of mineral water.

	R.	L.
Amt.	25 c.c.	30 c.c.
Δ	-0.25°	-0.23°
Sugar	Traces.	Traces.
N	0.084%	0.091%

No. 73. Karl B. 70 yrs. (Mogilnow, Posen.) *Vesical calculi.*

7. VII. For the last two years bladder symptoms, especially on riding on rough roads. No trouble during periods of rest. Urine stream not interrupted, urine cloudy, mixed with blood, often cramp of the bladder. Cystoscopy shows the presence of numerous urate stones (23 were counted).

9. VII. Lithotripsy under chloroform, following photography of the cystoscopic picture. The crushed stones consist principally of urates.

10. VII. Urine passed spontaneously without great difficulty, tinged with blood. Patient's general condition good.

14. VII. Cystoscopy shows the presence of only a single portion of a crushed stone. Phloridzin-injection 0.005, positive after 50 min., that is to say, *somewhat retarded*. Patient leaves the clinic cured.

No. 74. Joseph G. 61 yrs. (Married, merchant, Jekaterinoslaw.) *Contracted kidney. Tumor of the bladder.*

5. VII. During the last year has had hemorrhages which appeared at various intervals, often totally ceased, then reappeared, accompanied often by bladder cramp and severe pain. Patient is very anæmic, of cachectic appearance. Cystoscopy: Tumor situated on the left side of the floor of the bladder, with broad base, covered with blood clots, and of uneven surface.

7. VII. Irrigation bladder with arg. nitr. 1-1,000.

8. VII. Tenesmus somewhat diminished, no blood. Poor appetite, arg. nitr. 1-1,000.

10. VII. General exhaustion, singultus, less tenesmus. *Phloridzin reaction after first, second, and third syringefuls negative. Casts in sediment.*

12. VII. General condition improved. Urine no longer colored with blood, 24 hour amount 2,500 c.c.

13. VII. 24 hour amount 2,400 c.c. Spec. Gr. 1008, operation not advised.

14. VII. Patient leaves the clinic.

No. 75. Jakob L. Unmarried. 40 yrs. Cherson, Russia.
Tumor of bladder. Nephritis.

5. VII. In the last five weeks seven spontaneous hemorrhages have appeared. Five weeks ago L. noticed blood in his urine for the first time, soon afterwards the urine became clear again. L. knows of no reason to account for these hemorrhages. No pain accompanied them. Patient has had pain in the right kidney region in the last five days. Scalding pain often on urination. Gonorrhea 20 years ago, acquired syphilis 12 years ago. No stricture. Albumen proportional to the amount of blood. Hypospadias.

6. VII. The cystoscope cannot be introduced. A treatment with sounds is first necessary.

7. VII. Severe hemorrhage. Bladder irrigation with arg. nitr. 1-1,000. By rectum prostate is moderately enlarged, a hard mass palpable over it.

9. VII. Blood in the urine has diminished. Evening temperature 38.5. Cystoscopy: Tumor with firm base situated on the floor of the bladder.

10. VII. *Reaction after one syringeful of phloridzin (0.005) negative.* Left epididymis painful and swollen. In sediment *epithelial casts, pus.*

11. VII. 24 hour amount of urine 3,000 c.c. Spec. Gr. 1010, patient feels much exhausted.

13. VII. 24 hour amount urine 2,600 c.c. Spec. Gr. 1010.

14. VII. (Patient suddenly died in a bath-establishment outside the clinic, from unknown cause. Autopsy refused.)

No. 76. 6. VIII. 1896. S. 70 yrs. *Hypertrophy of prostate.*

Excision of vasa deferentia. Two years later as there was no improvement, a Bottini operation. Again no improvement and a second Bottini in Nov., 1898.

16. XI. Urine fairly clear.

23. XI. Urine again cloudy, pure pus at end of micturition. After irrigation and pressure on the prostate, nothing comes from the urethra.

2. XII. Urine fairly clear, 600 c.c. residual urine.
 4. XII. Urine quite clear, about 700 c.c. residual. Cystoscopy: diffuse though not severe cystitis, several diverticula. Both lateral lobes of the prostate enlarged.
 8. XII. Urine clear, 450 c.c. residual.
 12. XII. Urine clear, 450 c.c. residual.
 16. XII. Urine slightly cloudy, 700 c.c. residual.
 18. XII. Urine slightly cloudy, 600 c.c. residual.
 21. XII. Urine more cloudy, 600 c.c. residual.
 7. II. 1900. Phloridzin-injection 0.005. *Positive* reaction after 3 to 4 hours (*retarded*).

No. 77. G. 24. VII. 1900. *Nephritis*.

11 years of age. Five years ago had nephritis following scarlet fever. One syringeful phloridzin (0.005). Sugar 0.1 per cent. Reaction somewhat retarded.

No. 78. U. 16. V. 1900. *Chronic interstitial nephritis*.
 One syringeful phloridzin at 12.20 p. m.

Reaction negative after 18 min.

Reaction negative after 25 min.

Very slight precipitate after 30 min.

Good reaction after 35 min.

No. 79. Wilhelm Qu. *Nephritis*.

32 yrs. old, married. During last weeks patient has had œdema of the eyes, vomiting, headache.

22. VI. 1900. Blood, $\delta = -0.56^\circ$, urine shows 0.6 per cent. albumen. Uræmia, enormous amount albumen, headache, nephritis albuminuria, vomiting.

Phloridzin-injection. No sugar eliminated in the urine collected for $2\frac{1}{2}$ hours.

No. 80. Hermann S. (Kümmel's case.) 52 yrs., from Friedrichsberg. *Progressive paralysis. Fungus gen.*

High temperature, incision and drainage of the knee.

+

$\Delta = -0.71^\circ$, blood $\delta = -0.75^\circ$ U (average) = 11.0% (1)

Phloridzin—permanently *negative*.

Autopsy report: *Amyloid degeneration of the kidneys; bilateral chronic parenchymatous nephritis.*

No. 81. N. 82 years. *Hypertrophy of the prostate (contracted kidney?).*

Purulent urine, slight amount albumen.

Phloridzin-injection *negative*. Only the bladder urine was examined.

No. 82. Br. 72 yrs. *Enormous hypertrophy of the prostate (Bottini operation).* Reaction of the bladder urine *positive*.

No. 83. K. 74 yrs. (Pol. 4252.) *Hypertrophy of prostate. Cystitis. Retention of urine.*

Phloridzin-injection. Reaction of bladder urine *positive*.

No. 84. W. 73 yrs. *Enormous prostatic hypertrophy.*

Horne's lobe. Bottini's operation. Phloridzin-injection. *Positive* reaction in $\frac{3}{4}$ hour. Somewhat retarded.

No. 85. A. 26 yrs. 28. VIII. 1900. *Nephritis.*

Patient acquired gonorrhea four months ago, but had been perfectly well up to then. Four weeks ago he began to have tenesmus, cloudy urine, and pains in the right side of his back. Urine: acid, cloudy, milky, large amount of pus, 2.5 per cent. albumen.

Phloridzin-injection 0.005, *negative*.

Patient was sent to our clinic with a diagnosis of right pyelitis, and gonorrheal cystitis. The absence of the phloridzin-reaction caused us to suspect a nephritis. Phloridzin given again, 0.01. *No reaction.* $2\frac{1}{2}$ per cent. albumen and granular casts found.

No. 86. H. (Case of Kummel's, Hamburg.) *Contracted kidney.*

A man of 45 with a cardiac lesion was in the medical division of the Eppendorf-Hamburg General Hospital, and

was transferred to the surgical station on account of a supposed renal calculus. The patient had suffered for several weeks from a frequently recurring hæmaturia. It was found by the cystoscope that the blood came from the *right* ureter, while the fluid discharged on the left looked normal. The bladder urine in periods free from hemorrhage showed traces of *albumen*, but no casts. Ureteral catheterization gave the same result in regard to the origin of the hemorrhage as the cystoscopic examination. A diagnosis was made of tumor or calculus of the right kidney.

With a view to operation, the blood was examined and the *phloridsin* test done. The latter was wholly *negative*, no sugar being eliminated after an hour. δ of the *blood* = -0.63° . Accordingly the presence of a contracted kidney was assumed, and for that reason all idea of operating abandoned.

The patient's death, which occurred later, made an autopsy possible, which confirmed the diagnosis of *contracted kidney*.

No. 87. M. *Slight bilateral gonorrheal pyelitis.*

Patient had gonorrhea $1\frac{3}{4}$ years ago. Always well up to that time. In spite of all methods of treatment a slight permanent cloudiness of the urine remained. Man feels perfectly well, only symptom is purulent acid urine with a corresponding amount of albumen. Cured by irrigations of the kidney pelvis. U. C. (Phl.)

	R.	L.
Amt.	18 c.c.	22 c.c.
Δ	-1.42°	-1.44°
Sugar	1.6%	1.5%
N	0.63%	0.61%

No. 88. K. 19 yrs. (Klinik, Prag.) *Left renal tuberculosis.*

Urine has been cloudy since 1892, following an inflammation of the throat (diphtheritic). Small amounts of albumen are said to have been found. In that same year occurred a single attack of colic-like pain in the left sciatic region which lasted

an hour. This same sort of an attack recurred once in 1895. No cough, no expectoration, no night sweats. Grandmother on mother's side died of tuberculosis of the larynx. Heart and lungs normal.

Urine: acid, cloudy, contains pus, red blood corpuscles, no casts, no bacteria microscopically. Inoculation of the freshly collected urine on various culture media showed it was sterile.

The kidneys are not palpable. Kidney region not tender on pressure, nothing abnormal to be discovered about the prostate or testes.

Cystoscopy: On the left, the ureteral region is covered by vesicle-like formations with diffuse redness and swelling, so that the ureteral opening cannot be seen. Otherwise the bladder looks normal. The right ureter is easy to enter.

The urine collected from the right ureter is very slightly cloudy, which microscopically is found to be due to a slight hemorrhage (fresh red corpuscles, trauma). *No albumen* in the filtered urine from the right. The urine from the left kidney, which was collected from the bladder, is slightly cloudy, and contains leucocytes, red blood corpuscles and albumen. No tubercle bacilli found.

Sugar reaction following phloridzin present from both kidneys.

	R.	L.
Amt.	16 c.c.	10 c.c.
Δ	— 1.50°	— 0.91°
Sugar	2%	0.05%
N	0.63%	0.385%

Later a very few tubercle bacilli were found in a preparation from the bladder urine, and still *later* a guinea-pig inoculated with the urinary sediment died of tuberculosis.

No. 89. Mrs. K. 31 yrs. (Case of Landau-Thumin.)¹

¹ This case, most kindly placed at our disposal by Colleague Thumin, is described in detail in the *Berliner klin. Wochenschrift*, 1900, Nr. 45.

Right pyelonephritis with calculi.

Patient has had pus in her urine since November, 1899, at times blood mixed with it also. Examined cystoscopically March, 1900; signs of a slight cystitis. Urine collected separately from each kidney, absolutely free from all pathological constituents.

From May to June, 1900, the patient had repeated severe attacks of colic-like pain which she ascribed to the region of the right hypochondrium.

Entered the clinic of Professor Landau on 11 June, 1900. Examination under narcosis of all organs. Cystoscopy, and catheterization of the ureters gave no information. Discharged 19 June, 1900.

At the end of June, 1900, attacks of the severest sort recurred, elevation of temperature, appearance of a tumor on the right side below the liver. Soon afterwards there was a discharge of a large amount of milky purulent urine which extended over several days, and the tumor diminished in size. At the end of July patient was free from fever. Urine at times clear, at other times cloudy—an intermittent pyonephrosis was present.

Admitted into Professor Landau's clinic for the second time on 4 Aug., 1900.

No fever. At times the tip of a tumor is palpable in the right kidney region—later only with difficulty and on pressing down very deeply upon the abdominal wall.

7. VIII. 1900. Cystoscopy and ureteral catheterization: Bladder urine: cloudy, very purulent, albumen +, otherwise free from pathological elements.

Urine from the right kidney: Opaque whitish, cloudy. Sediment pure pus, albumen +, tubercle bacilli not discoverable, otherwise nothing pathological.

Urine from the left kidney: Clear, free from all abnormal constituents.

Suppurative pyelitis (right), probably with calculi.

10. VIII. 1900. Venesection, determination of the freezing point of the blood (after Koranyi) = -0.60° (without passing oxygen through it). Subcutaneous injection of phloridzin 0.005, simultaneous collection of the urine from each kidney separately by means of ureteral catheterization. At first abundant secretion on the right, very scanty on the left. On the left very pronounced positive reaction with Trommer's test, wholly negative on the right. New catheter introduced into the left ureter, and urine again collected separately—from both kidneys. *Now 20 c.c. from the right, and 76 c.c. from the left kidney discharged during the same interval of time.* Spec. Gr. on both sides 1001. Urine from the right kidney: Albumen +, contains much pus, sugar test (Trommer, Nylander, polarimetric) wholly negative. Urine from the left kidney: Albumen —, sugar (Trommer and polarimetric) positive.

Pyelonephritis calculosa dextra. Left kidney sound, and capable of function.

15. VIII. 1900. Professor Landau. Right nephrectomy.

Favorable course, amount of urine increasing from 760 c.c. the day after operation to figures varying between 1,200–1,500 c.c. in the week before discharge.

5. IX. 1900. Discharged well.

At the beginning of October, 1900, the patient reported in a letter that she felt perfectly well.

Macroscopic and microscopical findings of the preparation: Surface of the kidney flecked, portions pale, portions injected; consistency rather hard, previously flabby. Kidney pelvis distended spherically to the size of a hen's egg, in which concretions can be felt.

On section, cortex broadened, grayish-yellow, cloudy, not sharply differentiated from the more injected dark red pyramids.

In the greatly dilated kidney pelvis besides many small yellowish white and moderately hard concretions ranging in size from a pea to a bean, are three larger calculi with pro-

longations, which correspond to single dilated calices. The mucosa of the kidney pelvis is swollen, with dusky red injection, strewn with flecks of hemorrhage, and richly covered with fibrino-purulent deposits. From the depths of the calices, thick pus can be pressed out in several places.

Microscopically: the vessels in the pyramids are greatly gorged, especially near the foci of round-cell infiltration which are seen for the most part in the course of the collecting tubules, whose contour they wholly hide. Where collecting tubules are to be found, one often sees epithelial desquamation and hyaline plugs (casts). Round-cell infiltration in the cortex also. Casts in numerous tubules. The glomeruli of the whole cortex are invaded by masses of round cells, in places the loops of capillaries have undergone hyaline degeneration, or are already transformed into diffuse hyaline masses. Foci of round-cell infiltration, casts in the tubules, and glomerular changes even in the portions of the cortex directly under the kidney surface.

Pyelonephritis chronica calculosa dextra.

No. 90. 6. X. 1900. P. *Right nephrolithiasis.*

Patient had always been well until four months ago he had a severe attack of colic. There were severe pains in the right side below the costal border, which extended around into the back, and radiated forward down into the groin, accompanied by sweating and vomiting. During this time the urine was slightly cloudy, later it became clear again. The attack recurred. On examination we found *clear* urine free from albumen with occasional old blood cells (abnormal) and a few fresh corpuscles; few leucocytes.

Nothing palpable in the kidney region, and no tenderness there to pressure. Eight days later another less severe attack with slightly cloudy urine. In the interval the patient had only a feeling of weight in the right kidney region. U. C. (Phl.)

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	R.	L.
Amt.	18 c.c.	24 c.c.
Δ	— 1.30°	— 1.65°
Sugar	1.2%	1.8%
N	0.49%	0.63%

In glancing over the cases just reported, we do not need to concern ourselves with normal values, so far as they refer to N and Δ , since we have already said what was necessary in the previous chapter. [See page 138 ff.] On the contrary, let us briefly go into the question of the figures for the sugar eliminated.

I. IN NORMAL CASES THE FIGURES FOR BOTH SIDES AGREE IN A STRIKING MANNER. *The absolute values are generally high, 1 per cent. and over. In cases 24 and 31 where they are low it was due to a very dilute urine: in both cases a large amount of water had been taken before the examination. Compare on this point the following cases.*

Case 21.	Sugar. 0.9%	Case 22	1.8%
	0.8%		1.8%
Case 24.	0.4%	Case 25	1.6%
	0.4%		1.5%
Case 28.	1.4%	Case 31	0.2%
	1.4%		0.2%
Case 37.	0.8%		
	0.9%		

We find a single remarkable exception to the equality of sugar elimination in case 50, where differences of 0.7 : 0.15 exist for the sugar, in an apparently well

woman in whom also the parallel values of N and Δ pointed to a normal condition of the kidneys. Since this case has remained unique, we may well suppose that some undiscoverable error has crept in.

That the conditions of sugar elimination remain the same as we have just described them, even when the urine is collected in the second hour after the phloridzin injection, is proved by cases 41 and 71.

II. The most conspicuous interest, however, attaches itself to the figures we obtained in our examinations of *unilateral renal diseases*. It is enough to cite out of the various pathological affections one example. For further information one may refer to the cases.

Case 43, *tumor of the right kidney*, shows:

	R.	L.
N	0.56%	0.77%
Δ	-0.95°	-1.7°
Sugar	0	0.2%

All figures on the right are lower than on the left normal side. No sugar at all was produced by the right kidney.

Case 58, *calculus right kidney*, shows:

	R.	L.
N	0.38%	0.76%
Δ	-0.54°	-1.48°
Sugar	0	1.6%

The differences between the two sides in Δ and in the sugar are enormous. The lithiasis had existed

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for many years. Since no sugar at all was any longer eliminated by the right kidney, it is to be supposed that only a little renal substance capable of work remained.

Where less severe changes have been caused by *stone*, for example, case 45, we see a diminution of two tenths in the sugar elimination of the diseased side as against the normal side, or as in case 90, a lower value in all factors of the diseased side of about 20 per cent.

Case 67 illustrates a *pyonephrosis which must have taken up the greater part of the right kidney*.

	R.	L.
N	0.32%	0.78%
Δ	—0.48°	—1.18°
Sugar	0	1.0%

The diseased side no longer eliminated any sugar, while on the normal side we found 1.0 per cent.¹ The molecular concentration is considerably higher on the left than on the diseased side.

Case 65 is an excellent example of *unilateral tuberculosis*.

¹ In cases of a kidney sac (hydro- or pyonephrosis) one first is careful to empty the sac, and not to collect the urine for examination until an hour or so after the phloridzin injection. For if one were to examine the urine which was present in the kidney pelvis before the phloridzin injection, great errors would be unavoidable.

	R.	L.
N	0.30%	0.37%
Δ	-0.8°	-1.03°
Sugar	0.15%	1.2%

The left side thus eliminated eight times as much sugar as the diseased side. In the same way the freezing point on the left is considerably higher, while the N elimination is similar.

A *pyelonephritis* which had apparently destroyed only a moderate portion of renal tissue is illustrated in case 48.

	R.	L.
N	0.40%	0.31%
Δ	-0.78°	-0.59°
Sugar	1.2%	0.6%

From all these cases it is evident that on the diseased side a minus quantity of nearly all three values is always present in comparison with the normal side. This is especially true of the sugar elimination and the freezing point. The smallest discrepancies appear in the N elimination and thus it is the least trustworthy, for cases occur in which the diseased kidney excretes more N than the normal organ. (Cf. case 64.)

In general we see that the parallelism between the freezing point and the sugar elimination is very pronounced, while the relation of the N-amount to the other two factors is not so constant. We observe the same thing when we examine in this regard the cases of Albarran. Thus in case IV. Albarran, Bernard and

Bosquet (Urologen, Congress, 1899, p. 499) Δ right = -0.53° ; left = -0.60° ; that is practically equal, while the values for the urea are 0.434 and 1.17, which are considerably different. Observation XVI. Albarran (reported by Le Sard, Paris, 1900, p. 70) shows Δ left = -0.66° , right = -0.82° , only a small difference while the amount of urea from the right kidney, 0.96 per cent., is almost three times as much as from the left, 0.33 per cent. A similar condition appears in case XXV. Albarran (reported by Le Sard), where the values for Δ are -0.61° and -0.79° ; those for urea on the contrary are 0.76 per cent. and 1.4 per cent.

We wish briefly to call special attention to cases 54, 55, and 89, since in all three the results of the operation and the autopsy of the organs corroborated the correctness of the examination.

In case 54 the tuberculous kidney was transformed into several large purulent, cheesy cavities, and only little renal tissue remained. The examination preceding the operation had shown that *the freezing point on the left was only -0.56° , on the right three times as great, -1.51° ; that no sugar at all was eliminated on the left, but was on the right.* The tuberculous kidney was removed, and the patient recovered.

In case 55, the right kidney was to a large extent transformed into pus cavities, in which lay several calculi. *The freezing point of the urine from the left*

kidney was seven times as large as that of the right: No sugar was eliminated on the right, but at the normal time on the left. The amounts were not estimated in this case. The patient recovered from the nephrectomy.

In case 89, the condition of the kidney removed was interesting. It showed besides the pyonephrosis a very severe grade of nephritic changes which had extended through the entire organ, which was doubtless the reason for the total absence of sugar after the phloridizin injection.

III. Of great practical importance are finally the cases in which both kidneys were found diseased. Here we have to decide whether the existing disease contraindicates the operation, or whether in reference to this kidney's functional power which exists in spite of the disease, an operation on the other seems allowable. We cite several appropriate and instructive cases.

In case 29, a *double renal tuberculosis*, clear evidence of disease on both sides was present. Large amounts of albumen were excreted from both kidneys. The *molecular concentration was low* on the right as well as the left: *on the more diseased side sugar was totally absent, but also only traces of sugar were produced by the left kidney.* This last fact pointed to such an inadequate functional power that we believed any operative procedure was contraindicated.

Case 51 shows the same conditions—*tuberculosis of the right kidney, but also suppuration in the left. Quite a low freezing point left and right: -0.61° and -0.83° . Albumen and casts on both sides, but more than all, no sugar elimination from either side after phloridzin injection.*

Case 62 shows the opposite, that a disease of both kidneys can exist where one may still operate with good results, if only the kidney to be preserved still functionates. The diagnosis before the operation was: *abscesses of the right kidney, slight pyelonephritis on the left side.* Catheterization of the ureters had shown leucocytes and small amounts of albumen in the urine of both sides. Since however the freezing point on both sides, in spite of a very much diluted urine, was only slightly lowered and similar (-0.76° and -0.74°) and since furthermore both kidneys still produced sugar (the slight amounts are apparently due only to the dilution), an operation was not directly contraindicated. The result showed that the case was judged correctly. For the woman recovered and gained strength fairly well after the operation, her urine however at the time she left the hospital showed that the remaining left kidney was not fully normal. Although there was no cystitis, the urine still remained slightly cloudy.

These cases thus far are those in which the disease of the other kidney, not to be operated on, showed itself

through the demonstration of albumen or systemic elements. But case 61 shows that it was the phloridzin test alone which was able to call attention to the fact that the second kidney was not intact. N-elimination and J were small in amount on both sides. From the diseased side came *purulent and albuminous* urine, *on the other* however *it was clear and free from albumen*. One accordingly would have been justified in supposing this kidney was normal, if the phloridzin injection had not shown that the left as well as the right side no longer produced sugar. This functional incapability of the left kidney will be less astonishing and easier to understand if we glance at No. 60.

This is the same case examined three months earlier, at a time when the left kidney's urine contained albumen, and in enormous amount. In case the first examination had not been at hand, the inadequacy of the second kidney would not have been recognized at the time of the second examination if it had not been for phloridzin injection. One would thus have decided, from the conditions found, to operate on the right kidney, although as appears from the patient's history and the results of the examinations, a contracted kidney was clearly present on the left, which must be looked upon as a consequence of the nephritis existing at the time of the first examination.

Therefore this case is a brilliant proof, which we gladly and unreservedly submit, of the correctness of

the opinion expressed by Israel some years ago, that with the help of catheterization of the ureters *alone*, one cannot prove the disease or inutility of a kidney, since the urine may appear normal although the organ is diseased. What was however formerly impossible has now become possible through the introduction of the phloridzin test in combination with ureter catheterization—a fact which the case described proves most beautifully.

Cases 33 and 86 deserve mention here also. Case 33 is a patient with *calculus of the right kidney*, who died from heart paralysis three days after the operation. The autopsy showed *that both kidneys were not wholly intact, and that there was on the left side too a slight hydronephrosis*. The phloridzin injection brought out the fact that both kidneys eliminated a comparatively large amount of sugar (right side 1.0 per cent., left 1.4 per cent.). A hasty consideration might lead one to think that the phloridzin test had not proved its worth in this instance, but that is not true. The slight hydronephrosis which was present on the left side (about 30 c.c. in volume) had only slightly affected the kidney tissue and its functional power, and it may be assumed as certain, just as the operator also assumed, that if the cardiac weakness unrecognized before the operation had not caused the patient's death, the left kidney would have been fully able to carry on the work required by the system. For

although there was a slight dilatation of the kidney pelvis, no changes were demonstrable in the renal parenchyma.

In case 86 the *phloridzin test* was again used in combination with the determination of the freezing point of the blood. The disease and incapacity of the second kidney was thus recognized, and the patient and surgeon guarded from an operation.

The autopsy performed later proved the correctness of the assumption—for a contracted kidney was discovered.

V.

CONCLUSIONS.

We condense the results of our findings and investigations into the following conclusions:

1. *Kidney insufficiency cannot be determined from the examination of the renal excretion alone. The only theoretically well-founded method is the calculation of the molecular concentration of the blood (δ) as done by Koranyi. It will be the task of renal surgery to prove more fully than up to the present the limits of the method and its practical trustworthiness.*

2. *On the contrary, from the product of the kidneys, the urine, can be estimated the amount of work performed by each kidney (functional kidney diagnosis), however only with the aid of ureter catheterization. The methods employed which are conclusive on this point are:*

(a) *The quantitative estimation of single chemical elements in the separately collected urine, especially the nitrogen.*

(b) *More valuable than this is the determination of the molecular concentration (Δ) of the secretion of each kidney.*

(c) *The phloridzin test offers the most general indi-*

cation of the amount of renal function, that is, the quantitative determination of the amount of sugar eliminated by each kidney after the injection of phloridzin.

(d) *We ascribe particular value to the agreement of these indicators, of which especially that between the results of the freezing point and phloridzin tests is very pronounced.*

(e) *It is not requisite in these methods to collect separately the urine from both ureters, or (in certain cases) from one ureter and the bladder, for a long interval, since we are dealing only with values which we wish to compare.*

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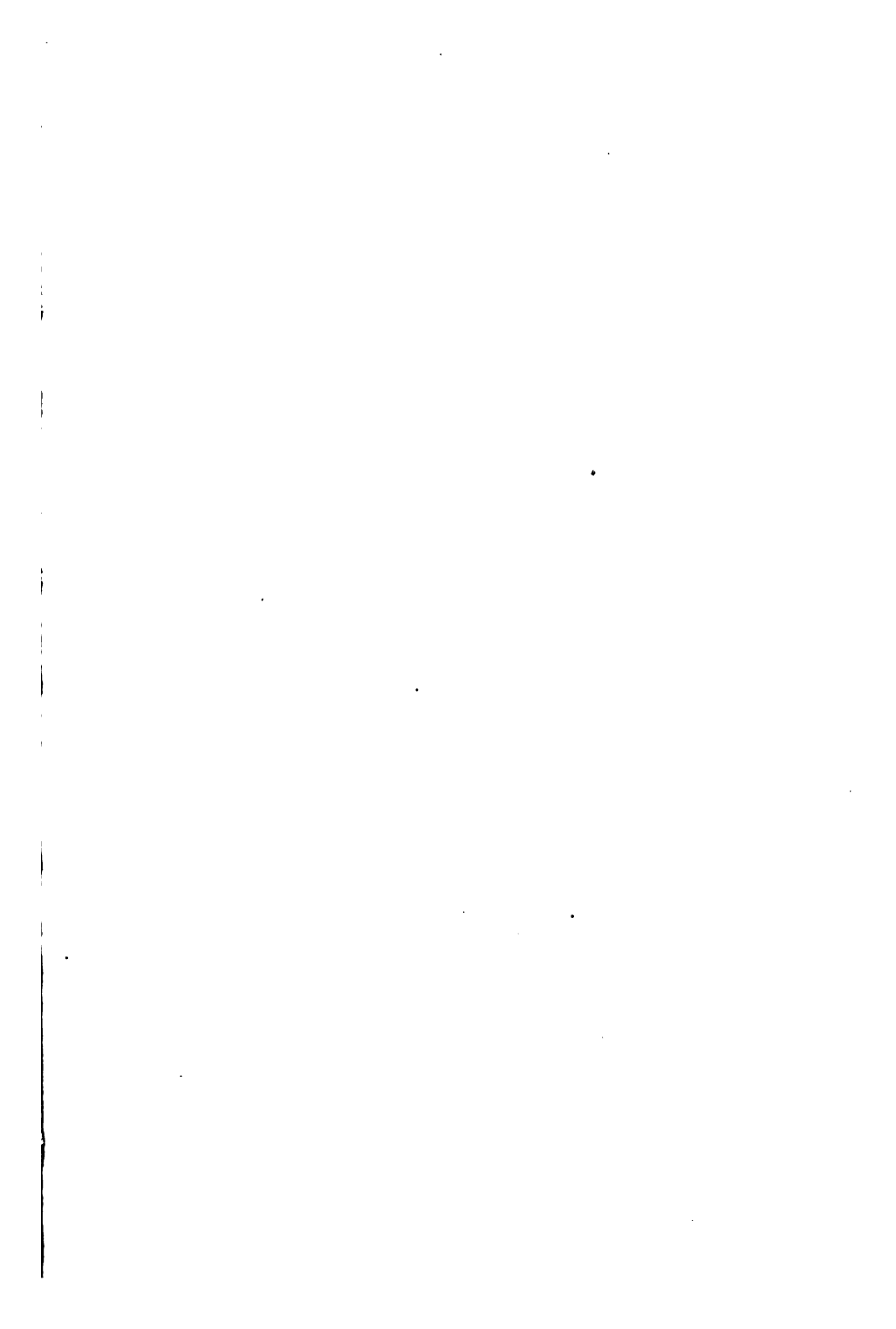
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